Lake Simcoe Environmental Management Strategy

STREAMBANK EROSION INVENTORY VOLUME I

TECHNICAL REPORT A.3

1985

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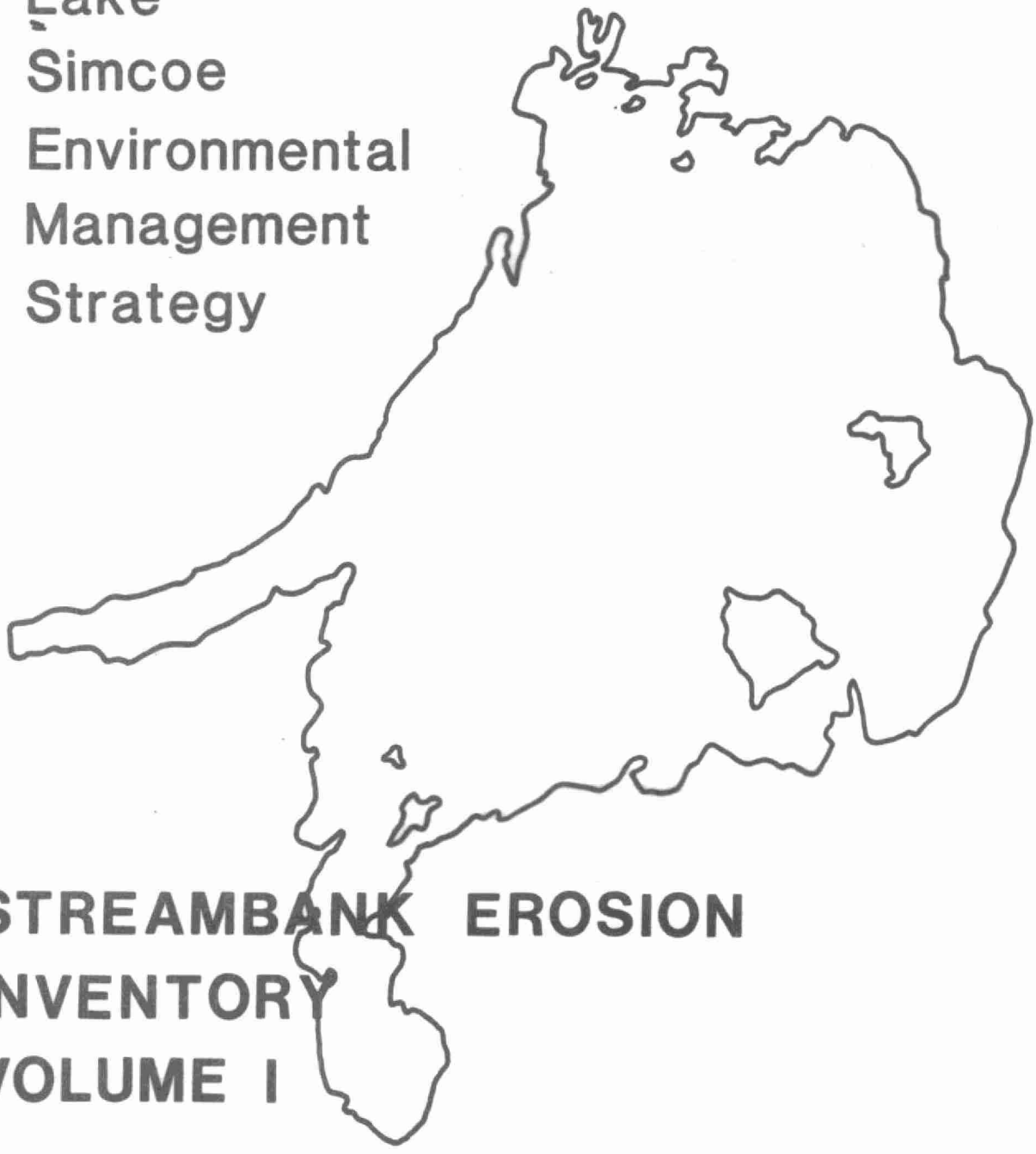

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LAKE SIMCOE ENVIRONMENTAL MANAGEMENT

STRATEGY STUDIES

STREAMBANK EROSION INVENTORY

FOR

HOLLAND RIVER

POTTAGEVILLE CREEK

KETTLEBY CREEK

GLENVILLE CREEK

AND

HOLLAND RIVER EAST BRANCH

Prepared for the Steering Committee of the Lake Simcoe

Environmental Management Strategy

by

John Antoszek
Trish Stam
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Technical Report Number A.3

Volume I

March, 1985.

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LAKE SIMCOE ENVIRONMENTAL MANAGEMENT STRATEGY

FOREWORD

This report is one of a series of technical reports prepared in the course of the Lake Simcoe Environmental Management Strategy (LSEMS) studies. These studies were initiated in 1981, as directed by the Cabinet Committee on Resources Development, to investigate methods of reducing phosphorus loadings from the Holland Marsh.

The studies are under the direction of the LSEMS Steering Committee, which is comprised of representatives of the following agencies:

- Ministry of Agriculture and Food
- Ministry of the Environment
- Ministry of Natural Resources and
- South Lake Simcoe Conservation Authority

This Committee expanded the SCOPE of these studies to include the total Lake Simcoe basin. This change in study mandate was made to place all sources of phosphorus loadings to Lake Simcoe into perspective. Thus the following sources were investigated:

- agricultural and rural runoff
- urban runoff
- streambank erosion and
- sewage treatment facilities.

In order to develop practical abatement measures to minimize such inputs, studies were initiated to inventory, quantify and target areas with respect to soil loss, livestock and farming operations, streambank erosion and urban runoff.

The Committee also approved Lake Simcoe studies to establish current information on lake water quality and aquatic plant growth. Such studies were required to establish baseline conditions to compare future water quality conditions. These are expected to improve, because of the following:

- municipal and provincial efforts to reduce phosphorus loadings from sewage treatment facilities and
- because of expected changes to more environmentally acceptable land use practices by developers and farmers to reduce inputs from non-point sources.

Questions with respect to the contents of this report should be directed to:

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Summary

The purpose of this study was to assemble a streambank erosion inventory for watercourses in the south-west section of the Lake Simcoe watershed. These watercourses included the Holland River, Pottageville Creek, Kettleby Creek, Glenville Creek, Holland River East Branch and their their tributaries. This inventory is a catalogue of the locations, type, extent, and severity of all the erosion problem sites discovered. Remedial measures to alleviate the erosion problem are suggested following each site description.

A total of 289 streambank erosion problem sites on 23 streams or tributaries were identified. Over 50 percent of the problems were due to natural streambank erosion. Twenty five sites were identified as having major erosion problems; 18 other sites were found to have extremely severe erosion problems. The main stream of Kettleby Creek claimed the most major and severe problem sites with 7 and 8 respectively.

Since the costs for remedial measures for the individual problem sites are highly site-specific, a range of costs has been determined. It is estimated that the costs of remedial measures for the extensive, major and severe erosion problem sites in the entire study area would be between $340,000 and $570,000.

1.0 INTRODUCTION

This study was conducted in order to assemble a streambank erosion inventory for watercourses in the south-west section of the Lake Simcoe watershed (see figure 1). This inventory included erosion problem site descriptions, pictures and maps of the problem sites, a problem severity rating, and suggested erosion control methods. Lastly, the range of expected costs for the implementation of remedial measures was determined.

Streambank erosion problem sites were catalogued for the area extending from the south-western most tip of the South Lake Simcoe Conservation Authority boundary, east to the York-Durham Counties boundary, and north to the confluence of the Holland River and the Holland River East Branch. The streams studied include: the Holland River (or Schomberg River) and its twelve tributaries; Pottageville Creek; Kettleby Creek and three of its tributaries; Glenville Creek; and the Holland River East Branch and its three tributaries.

The types of streambank erosion problems identified were:

1) natural bank erosion (undercutting, slumping, sloughing, bank mining, etc.),
2) gullying,
3) livestock trampling and access, and
4) inappropriate practices (regrading, dumping,

machinery trampling, etc.).

Note that the natural bank erosion label is meant to describe the type of erosion and does not imply that the causes of the erosion problem are natural.

Each problem site received an Erosion Problem Severity (EPS) rating in the form of a numerical variable. The numerical values correspond to severity as follows:

1 - a minor but contributing erosion problem,

2 - a moderate erosion problem,

3 - an extensive erosion problem,

4 - a major erosion problem,

5 - a severe erosion problem.

The expected costs of remedial measures were evaluated in light of costs of recent streambank improvement projects carried out by the South Lake Simcoe Conservation Authority (SLSCA) and the Maitland Valley Conservation Authority. As the actual cost of implementing remedial measures for any individual streambank erosion problem site depends on the accessability of the site and in-situ conditions, costs on an individual site basis have not been determined. Instead, a range of cost per type of remedial measure based on project experience was determined. Since few projects were undertaken to correct minor problems, the ranges of cost only apply to remedial measures for sites in the three worst EPS ratings.

2.0 WORK PROGRAM ACTIVITIES

The Conservation Authority's Stream Survey reports and the Coldwater Stream Habitat Assessment reports were reviewed prior to beginning field work to familiarize the field crew with the study area. The Conservation Services' Erosion Control Manual (Vol. 1) was used to aquaint the field crew with the types of erosion problems and possible remedial measures. Discussions were held with the Conservation Authority streambank erosion study crews in order to standardize conventions used in field work and mapping. Past streambank erosion studies were reviewed to aid in determining the final report structure.

A data sheet was prepared so information from the field could be recorded for future use. Provisions were made on the data sheet to record information on:

the dimensions of the problem area,
stream and bank conditions,
adjacent land uses,
the type(s) of erosion at the site, and
the severity of the erosion problem.

A section was included to record photographic information to ease the matching of site descriptions with photographs of the erosion problem. To complete the data sheet, space was reserved for a diagram or additional comments. The additional comments could, for example, include: notes on

the location of the site, any structures affected by the erosion, or the possible cause or solution of the problem. An example data sheet can be found in appendix A.

Maps and orthophotographs (air photos corrected to remove relief and tilt effects to permit accurate scaling) were surveyed prior to the field work on each section of the stream. This familiarised the crew with the location of the stream and gave them a general idea of the stream conditions. Recent aerial photographs and a stereoscope aided in plotting stream courses through heavily wooded areas.

Field work included walking the stream courses and recording erosion sites. At each site, a data sheet was filled out, a black and white photograph was taken, and the site location was recorded on an orthophotograph.

The field crew worked in the office an average of one day in five. The completed data sheets were used to prepare site descriptions. The films were developed, contact prints and enlargements of site photographs were made. The site descriptions are found in appendix B.

During the final weeks the crew worked in the office compiling this report. The orthophotographic maps and photographs are on file at the Conservation Authority office.

3.0 FINDINGS

A total of 289 streambank erosion problem sites were identified in the study area. Over 50 percent of the problems were due to natural streambank erosion. A breakdown of the number of sites per rating and problem type is presented in table 20 and represented graphically in figures 2 and 3.

3.1 HOLLAND RIVER - MAIN STREAM

The Holland River originates at Hall Lake located west of Concession 12 and south of Sideroad 19 in King Township. The river flows in a north-easterly direction until it joins the East Holland river south of Cook Bay. The study of the West Holland concluded at Highway #9, 15 km from its source, where the river flows into the Holland Marsh canal system. See figure 4.

At the time the stream was studied the width was, on average, 2.4 m-3.0 m wide. The maximum width of the stream was located at a site where flow around an obstruction increased the stream's width to 8.8 m. Towards the source of the stream, the width varied between 0.6 m and 1.2 m. The depth of the stream averaged between 15 cm and 30 cm. A maximum depth of 1.5 m was found in a stretch of the stream within the

forested region between Tecumseth Sideroad 24 and Highway #9.

The condition of the streambanks varied from well formed, stable slopes to low marsh land. The streambanks were generally vegetated with grasses, or with a combination of trees and grasses.

The Holland River flowed through a variety of land uses. Much of the area was farm land, with the majority being pasture. In Schomberg and Lloydtown, it flowed through residential and commercial areas. Forested areas were scattered throughout the basin, although most of these were found either in the area where the stream entered the Holland Marsh Canal or in the headwater region. Swampy conditions were found near the headwaters.

Eighteen of the forty erosion problem sites found were classed as natural bank erosion types (Table 1). The majority of these 18 sites were either considered minor or moderate erosion problems. Only two of the sites were given erosion problem severity (EPS) ratings of 5. One of these was a site of slumping, the other was an area of flooding caused by a large beaver dam. Gullying accounted for 15 of the 40 sites. Most of these were minor to moderate problems (EPS rating of 2 or less). Five sites were attributed to cattle access and trampling, the worst site had an EPS rating of 4. Two sites of inappropriate practices were noted, both

were due to regrading. One was given an EPS rating of 3, the other, 4. See figure 5.

3.2 HOLLAND RIVER - TRIBUTARY A

This tributary has two branches that join east of Sideroad 17. Their sources are 1.5 km west of Sideroad 17 between Lines 2 and 3 of Tecumseth township. It is not until just west of Sideroad 17 that there was any water flowing in either of the two channels. The stream flows east for 4.5 km to where it enters the main stream at a point south of Highway #27 and north of Highway #9. See figure 6.

The stream varies in width from a maximum of 7 m to a minimum of 1.5 m. This stream's maximum depth was 30 cm, the minimum was 10 cm. The area through which this stream flows is either pasture land or land planted with grains. The streambanks throughout the area are grass covered.

Natural bank erosion (undercutting or slumping) account for 4 of the 7 erosion problem sites (Table 2). Of these 4, two are rated as minor problems and two are moderate problems. The two sites of inappropriate practices and the one livestock trampling site were all considered minor erosion problem sites. See figure 7.

3.3 HOLLAND RIVER - TRIBUTARY B

Tributary B originates west of King Concession 12 south of Highway #9, it enters the main stream north of Highway #9 and of Tecumseth Sideroad 20. The tributary is 7.25 km long. Only 6.25 km of it was studied, however, as the upper 1 km of the stream was dry. See figure 8.

The stream ranged from 0.60 m to 1.2 m in width. The widest it ever became was 4.5 m, due to regrading of the banks. The maximum depth of the stream was 60 cm, the minimum depth was 15 cm. The stream flowed mainly through pasture land and areas of scrub. The streambanks were generally grass covered.

Of the 18 sites recorded along this stream, 10 were of natural bank erosion types (Table 3). Most of the sites were considered to be minor or moderate problems. However, two of the sites did receive EPS ratings of 5. Inappropriate practices accounted for 4 minor erosion sites. Minor, moderate and extensive were the individual ratings given to the three sites of gullying. The only trampling site along this tributary was rated as a minor problem. See figure 9.

3.4 HOLLAND RIVER - TRIBUTARY C

The three branches of tributary C originate in the area east of Concession 10 and south of Highway #9 in King Township. The branches are separated from one another by approximately 500 m. All three branches join 1 km east of Concession 10. This tributary flows 1 km further east to join the main stream at a point south of Highway #9 west of Main Street in Schomberg. See figure 10.

Approximately 4 km of stream was studied. The maximum width and depth were found to be 1 m and 30 cm respectively. At the headwaters, the minimum width and depth are 20 cm and 10 cm respectively.

From the mouth the stream flows through fallow fields where some regrading and dumping had been done, and through an area of cattle access. The stream splits into the three branches. The north branch runs through farm fields most of which are planted with hay. On this branch, the stream has cut a deep bed and the land is worked to the edge of the stream. The centre branch flows through a heavily wooded area where the stream flows through many channels. There are also two swampy areas through which the main channel is indistinguishable. The southern branch flows through farm fields.

Of the eleven sites recorded, five were of natural bank erosion, three were gullies, two are of trampling, and one was caused by heavy farm equipment (Table 4). All of the sites had an EPS rating of 3 or less. See figure 11.

3.5 HOLLAND RIVER - TRIBUTARY D

Tributary D is 3 km long. The headwaters are located in an area south of Lloydtown just west of Concession 10 in King Township. The stream flows northeast to meet the main stream at the south end of Main Street in Schomberg. See figure 12.

The stream has passed under a bridge at the south end of Main Street in Schomberg and gone through a ravine behind a new subdivision. This subdivision was under construction and the machinery has trampled the banks where the stream has been forded. Above the construction area, the stream flowed from an orchard and cattle pastures. Across Sideroad 19, the stream flowed from cattle pasture, hay and grain fields. In this area the stream has been dredged. The dredgate has been put on the banks. From here to Concession 10, the stream had run along the road as a ditch for about 20 m. Before passing under the road it had run along the other side for 80-100 m after running northeast from the source at a farm pond.

There were eleven erosion problem sites along the length of the stream (Table 5). Four sites of trampling were located, two with EPS ratings of 1, one with a rating of 2, and one with a rating of 3. There were three gullies, one rated as a major problem (EPS rating of 4). There were three sites of inappropriate practices, none rated worse than extensive (EPS rating of 3). In the natural bank erosion classification, there was one minor site (EPS rating of 1). See figure 13.

3.6 HOLLAND RIVER - TRIBUTARY E

Tributary E is 2.5 km long. It stretches from just north of Sideroad 18, between Concessions 11 and 12, to Concession 10 north of Sideroad 19. See figure 14. The lower section of this stream flows through flat, fallow fields. Some residential land borders the stream although the majority of the adjacent land is farm land.

The area near the mouth is made up of high, rounded hills and the stream flows through a ravine. South of this, the stream joins a drainage ditch as it flows beside a ploughed field. Upstream of the field, the stream flows through a dump site. Downstream of the source, the stream meanders through pasture. The headwaters are found near a residential area in a swamp on the south side of sideroad 18.

There were only two erosion problem sites on this tributary (Table 6). One site was a minor gully caused by runoff from the ploughed field. A major inappropriate practices problem was catalogued at the dump site. See figure 15.

3.7 HOLLAND RIVER - TRIBUTARY F

Tributary F is 3.5 km long. Its mouth is located half way between Concessions 10 and 11 in King Township, just north of Sideroad 19. The headwaters are found at Concession 12 just north of Sideroad 19. See figure 16.

From the mouth at the edge of a forested area, the stream makes a large "S" shaped curve and runs west along a dredged water way. The banks are high and irregular because of dredging. Upstream of the crossing at Concession 11, the stream is straight and is used as a ditch between two hay fields. Further west the stream passes through cattle pastures and into a wooded area where the banks are wet and soggy. The stream follows a fence line and the channel breaks up in to many channels for about 100 m. Near the headwaters the stream flows through a wooded ravine to Concession 12.

There were eleven erosion problem sites in total on tributary F (Table 7). Four of these sites, rated as minor to moderate (EPS 1-3), were of natural bank erosion types. Three gullies were found, they were assigned EPS ratings of one, two, and three. Three areas of inappropriate practices were located; a washed out bridge (EPS rating of 1), an obstruction (EPS rating of 1), and heavy machinery trampling (EPS rating of 4). There was also one cattle trampling problem site that received an EPS rating of 3. See figure 17.

3.8 HOLLAND RIVER - TRIBUTARY G

Tributary G is 7.5 km long. This stream originates south of King sideroad 18 between the 10th and 11th concessions and joins the south drainage canal south of Highway #9 west of the Pottageville swamp. See figure 18.

Extending from the south canal just west of where the main stream of the Holland River enters the canal, tributary G travels west through cattle and sheep pastures until it reaches concession 8. West of the concession, the stream bed has been dredged so the course of the stream now follows a drainage ditch. There are a number of areas where the farmers have worked their lands to the edge of the streambanks. At the end of one field, the stream divides into two branches, both of which bend to the south. One

branch crosses the Lloydtown Road and ends at a swamp. The other branch crosses Highway #27 and turns south to Sideroad 18. This second branch flows through residential areas, pastures, and through a wooded area. In this forested area the stream has bare banks rising to 4.5-5.0 m.

In all, nineteen erosion problem sites were discovered, the majority of which were gullies and natural bank erosion types (Table 8). Three sites of cattle trampling were found. Three sites of inappropriate practices were caused by dredging, cultivation to the edge of the stream, and an obstruction that is changing the course of the stream. None of the sites on tributary G were assigned an EPS rating greater than 3 (moderate). See figure 19.

3.9 HOLLAND RIVER - TRIBUTARY H

The length of tributary H and all of its branches is 12.7 km. The first 2 km flow through the Pottageville swamp beginning near Highway #9 at the south drainage canal and stopping approximately 1 km north of the Lloydtown-Pottageville Road. This area was not investigated. See figure 20.

The stream meandered through tall grass fields north of the Lloydtown Road. South of the Road, the stream followed a

heavily wooded area until its headwaters. The headwaters sprang from a grassed ravine north of Sideroad 17. Three smaller branches fed the main watercourse. One entered from the west originating at Sideroad 18 and Highway #27. Two more entered from the east. The tributary furthest south was dry until it reached a road-side ditch along Concession 8. The width of the northern branch ranged from 30-60 cm. This branch flowed in a grassed waterway.

The main stream's maximum width is approximately 2 m, the average width is 1 m. The depth ranged from 10 cm to more than a meter.

Twenty three erosion sites were noted on tributary H, all sites have minor to moderate EPS ratings, save one (Table 9). The only major site was found in the southern section of the main watercourse where undercutting had occured along a bend of the stream. Eighteen of the 23 sites were classed as natural bank erosion types, 3 sites were due to gullies, and 2 sites were due to inappropriate practices. See figure 21.

3.10 HOLLAND RIVER - TRIBUTARY I

Tributary I is 5 km in length. Three km of which cross the Pottageville swamp area south of Highway #9 and,

therefore, were not investigated. See figure 23.

From the Lloydtown Road to Weston Road, tributay I crossed farm lands and ended in a pond at Weston Road. The width of the stream never exceeded 15 cm.

No erosion problems were found on tributary I.

3.11 HOLLAND RIVER - TRIBUTARY J

Tributary J was much the same as tributary I. The length of its two branches measured 4 km in total. Both branches also flowed into the swamp area south of Highway #9. The portions of the branches that ran through the swamp were not investigated. See figure 23.

This tributary ran through Carrying Place Golf and Country Club. The stream banks were well vegetated and in good condition.

No erosion problems were found on tributary J.

3.12 HOLLAND RIVER - TRIBUTARY K

Tributary K is 3 km long. The stream originates in an

area south of Highway #9 east of Highway 400 and flows to the south drainage canal west of King concession 5. See figure 23.

The width of the stream ranged from 0.15 m to 1 m. The upper reaches of the stream meandered through a wooded area vegetated with cedar trees. The banks were wet and soggy although there was little flow in the stream. The lower half of the tributary ran through pastures and open fields. There were no sites south of Highway #9.

Four sites were noted on tributary K: two caused by obstructions (EPS ratings of 1); and two were of natural bank erosion types (one site rating 2, and one 3). See table 10 and figure 22.

3.13 HOLLAND RIVER - TRIBUTARY L

Tributary L flows into the South Drainage Canal of the Holland Marsh north of Highway #9 east of Kettleby Creek. Its headwaters are 6 km upstream at Sideroad 19 and Concession 3. See figure 24.

From the mouth, the stream traversed open fields in a straight line, its width ranged from 30 cm to 40 cm and its depth was approximately 30 cm. Upstream, the stream wound

through a cattle pasture north of Highway #9. The two branches of this stream joined as they enter a wooded area on the south side of Highway #9. The northern branch flowed from the east between tree lined banks. The southern branch also flowed from the east across another farm. This area was well maintained. The stream had mown grass banks. This branch meandered northwest through a wide, intermittently forested ravine, from its sources near Sideroad 19.

There were eleven sites recorded on tributary L. Six sites were of natural bank erosion types, these ranged in erosion problem severity from minor to severe (Table 11). The site with the EPS rating of 5 was located on the north side of Highway #9. One minor gully caused by road runoff was located at the culvert under Sideroad 19. Three minor sites of trampling were also catalogued. Heavy machinery had degraded the stream bank at one site (EPS rating of 2) north of Highway #9. See figure 25.

3.14 POTTAGEVILLE CREEK

The Pottageville Creek extends for 7 km from its source area to its mouth. The headwaters originate east of Weston Road south of Sideroad 17. The tributary flows northwest until it reaches the old gravel pit north of the Pottageville-Lloydtown Road west of Concession 7 of King

Township. The stream ends at this gravel pit. Only the lower 4.5 km of the stream were studied, as the upper part of the waterway was dry. See figure 26.

The stream was no more than 0.3 m deep for the most part, and towards the headwaters the depth decreased to a few centimeters. Grasses and trees are the primary vegetation along the streambanks. In the upstream area the adjacent lands are dense forests. In the downstream area the adjacent lands are mainly residential.

All four of the erosion problem sites along this stream came under the category of natural bank erosion (Table 12). The highest EPS rating that any of the sites received was 3. The site that received this rating was one of undercutting found in the residential area. The other erosion sites were located within the forested region. See figure 27.

3.15 KETTLEBY CREEK - MAIN STREAM

The source of the Kettleby Creek is located south of Sideroad 17 between Jane Street and Concession 4 of King Township. From here it meanders northward to its mouth on the South Drainage Canal of the Holland Marsh. The length of this stream is 10 km. See figure 28.

For the most part, the streambed was covered with rocks and gravel. The maximum depth of 1.5 m was found south of Kettleby near a pond. A minimum depth of 30 cm was located in various areas along the stream. The maximum width of 6.1 m was found on a stretch, located north of Kettleby, where undercutting had eroded away one of the banks. The width of the majority of the stream ranged between 3 and 4.5 m. Towards the headwaters, the minimum width of 1 m was located. The streambanks were vegetated with grasses and/or trees.

The land uses adjacent to this stream include forested, residential, park, swamp, and pasture lands. The majority of the area that the stream flows through is forested. The lands adjacent to the stream through Kettleby and the surrounding area are residential with a small area of park land. In the region of the headwaters there area couple of marshy areas. The region near the mouth of the stream is all pasture land.

Natural bank erosion type problems accounted for 31 of the 43 catalogued sites (Table 13). These problem sites ranged in EPS values of 1 to 5 (minor to severe). Gullies accounted for 5 of the sites, two of which rated EPS values of 5. Four of the erosion problem sites were attributed to inappropriate practices. Three of these sites were rated as minor problems but the forth, caused by heavy machinery, was rated as a severe erosion problem. Trampling by livestock

accounted for only three of the 43 sites, all three sites were rated as moderate problems. See figure 30.

3.16 KETTLEBY CREEK - TRIBUTARY A

Tributary A originates near Jane Street (King concession 5) , about 100 m south of the Lloydtown-Pottageville Road and enters the main stream south of the lake in Kettleby. The tributary is approximately 1 km long. The maximum width of this stream is 45 cm near its mouth and it has a minimum width of 15 cm at Jane Street. The tributary flows in a grassed waterway through most of its length. See figure 30.

No erosion problems were found on tributary A.

3.17 KETTLEBY CREEK - TRIBUTARY B

Tributary B is approximately 1.25 km long. Its width remains constant at 15 cm as it flows from the small pond east of concession 4 from which it originates, and its confluence with the main stream between the Lloydtown Road and Sideroad 18. See figure 30.

No erosion problems were found on tributary B.

3.18 KETTLEBY CREEK - TRIBUTARY C

Tributary C of the Kettleby Creek has two branches that both originate east of King concession 4 between Sideroads 17 and 18. These two branches join just west of Concession 4. The tributary enters the main stream north of Sideroad 18. The total length of this tributary is 5 km. See figure 29.

The streams were only 30 cm wide throughout most of their length. The stream's maximum depths were only 15 cm and in quite a few places the streambeds were dry. The streambanks were generally grass covered. The adjacent lands were mostly wooded with the exception of a couple of scrub and swampy areas.

The stream had six erosion problems that were of the natural bank erosion types (Table 14). The worst half of the six had EPS ratings of 3. The gullying, trampling, and inappropriate practices type problems each accounted for 2 of the 12 sites along the stream. The sites of trampling and inappropriate practices are considered as minor to moderate problems. Of the two gullies, one is rated as a moderate problem and the other is rated as a severe problem. See figure 30.

3.19 GLENVILLE CREEK

The Glenville Creek was studied from its source, south of Highway #9 and east of King Concession 3, to its mouth at the South Canal southwest of Ansnorveldt. The length of Glenville Creek is approximately 5 km. Unlike the other streams in the area, this creek is mainly fed by ponds. See figure 31.

The stream width varied from 1 m to 3.6 m. The stream was roughly 15 cm deep on average. However, below the drop structures of the ponds in the source region, the stream depth was approximately 0.6 m deep. The streambank vegetation generally consisted of grasses or trees or a mixture of both. The majority of the adjacent land was forested although there were also small areas of swamp, residential, and pasture land.

Natural bank erosion type problems were found to be predominant accounting for 4 of the 9 problem sites (Table 15). All of these problem sites were given EPS ratings of 1. Gullying and inappropriate practices each accounted for 2 sites. The highest EPS rating in the gullying category was 2. The inappropriate practices category contained a site with an EPS rating of 5. Trampling accounted for only one

site along the entire stream length. This site received an EPS rating of 3. See figure 32.

3.20 HOLLAND RIVER EAST BRANCH - MAIN STREAM

The Holland River East Branch originates east of Highway #48 within the swampy area west of Musselman Lake. The river flows westward through Vandorf until, east of Aurora, the direction changes and the flow swings northward. The river passes through Newmarket, Holland Landing, and River Drive Park before joining the Holland River just south of Cook Bay. The total length of the river is 42 km. See figure 33.

The stream water quality environment along the river varied greatly. In some areas, there was a great deal of suspended solids, whereas in other areas, the stream was relatively clear. As the river flowed through the town of Newmarket there was an increase in the amount of garbage in the water. It was found that water quality degraded as the investigation continued downstream.

The maximum width of the river was approximately 50 m. This was the width along most of the river between Holland Landing and the confluence with the Holland River. The river was narrowest in the region of the headwaters where the average stream width was between 30-60 cm. The depth of the

river varied from only 15 cm in the headwaters to 2-4 m in the channel north of Holland Landing. The average depth of the stream through the central section was 0.60 m-1.2 m.

In the headwater region, the stream flows through swampy areas. The banks are vegetated mainly with reeds. Between the headwaters and Newmarket, the stream flows through pasture land, forests, and some residential land. The streambanks are vegetated with grasses or a combination of grasses and trees. In the town of Newmarket the surrounding lands are either residential or commercial. Here the streambanks are grass covered. Downstream from Newmarket, the stream passes through farm land and wooded areas. Along this section of the stream, the banks are vegetated with grasses and trees. The area north of River Drive Park is marshy, the banks are covered with reeds.

Of the 29 recorded sites 10 were of natural bank erosion types (Table 16). The one site that received an EPS rating of 5 was a natural bank erosion problem compounded by cattle trampling. Most of the sites in this classification were considered to be extensive or major problems. Gullying accounted for 9 sites with the majority considered to be minor or moderate problems. The highest EPS rating received was 3. Both trampling and inappropriate practices had 5 sites each. The highest EPS rating assigned in each of these classes was 3. See figures 34 and 35.

3.21 HOLLAND RIVER EAST BRANCH - TRIBUTARY A (WESTERN CREEK)

Tributary A originates west of York Manor in the town of Newmarket, and flows for 3.5 km in a northeasterly direction to where it enters the main stream at a point east of Main Street north of Davis Drive. See figure 36.

On the average the stream was approximately 1 m wide. At the mouth the width increased to roughly 6 m. The stream was on average 15-30 cm deep. The greatest water depth was noted at the mouth where the stream measured to be 1 m deep. The banks along the stream were usually grass covered.

Inappropriate practices were responsible for half of the 6 problems along this stream (Table 17). These problem sites consisted of erosion around a culvert, undercutting around a man-made obstruction, and erosion around a tile drain. None of these sites received an EPS rating greater than 2. Two problem sites were created by bank slumping. One site was considered as a moderate erosion problem and the other as an extensive problem. The final site was attributed to gullying. This site was assigned an EPS rating of 5. See figure 37.

3.22 HOLLAND RIVER EAST BRANCH - TRIBUTARY B (BOGART CREEK)

Bogart Creek measures 8 km from mouth to headwaters. The mouth is located just north of the Queen Street bridge in Newmarket. The headwaters are east of East Gwillimbury Concession 5 south of St. John's Sideroad. See figure 38.

The stream's maximum width was approximately 2.5 m-3.0 m and the minimum width, found in the area of the headwaters, was 15 cm. The depth ranged from 15 cm to 2 m.

The section near the mouth flows through a residential area in Newmarket. The Bogart flows past the estates off Gorham Street and goes through the woods between here and Bogarttown. This bush is very thick and many cedars have slumped over toward the stream. Upstream of the lake in Bogarttown the creek runs roughly parallel to Mulock Drive until it crosses Woodbine Avenue. East of Woodbine, the creek flows from farm fields and cattle pastures. This is the location of one of South Lake Simcoe Conservation Authority's livestock access restriction projects. The stream meanders through fallow fields southeast of this farm and then enters more bush area. Before crossing St. John's Sideroad, the creek flows parallel to East Gwillimbury Concession 5 and crosses another cattle farm. The stream begins across the concession to the east in a swampy region draining two small lakes.

Twenty one erosion problem sites were noted on Bogart Creek. Natural bank erosion type problems accounted for thirteen sites, four were gullies, and three areas of cattle access were found (Table 18). The one inappropriate practice site found was a manure pile placed about 100 m above the stream on a hill. The highest EPS rating assigned to any site on this tributary went to a gully that was considered a major erosion problem (EPS rating of 4). See figure 39.

3.23 HOLLAND RIVER EAST BRANCH- TRIBUTARY C (TANNERY CREEK)

The results of an investigation of the erosion problems on tributary C were presented in the Tannery Creek - Holland River Watershed Study Final Technical Report, April 1982 by Marshall, Macklin, and Monaghan. The field work that still needed to be completed covered 4.5 km of the lower stream (north of St. John's Sideroad). Three branches were investigated. The first section studied was the main branch of tributary C from the corner of St. John's Sideroad and Highway #11 to the confluence with the main stream of the Holland River East Branch north of St. John's Sideroad east of Highway #11. The second section studied was a branch of tributary C located south of Mulock Drive and east of Bathurst. The final branch of tributary C investigated flowed from St. John's Sideroad and Bathurst St. to St.

John's Sideroad at the Aurora Conference Centre. Other tributaries south of Aurora were dry and were not investigated. See figure 37.

Except for one cattle farm located between Highway #11 and the railroad tracks east of the highway, all of the investigated area was heavily forested. The creek meandered through this area making for numerous sites of undercutting. Near the headwaters of the northwest branch stormwater runoff from an area of road construction has lead to the formation of small gullies.

There were eight erosion problem sites located on Tannery Creek (Table 19). Four were of the natural bank erosion types, two of which were given EPS ratings of 4. One gully site was found that also received a rating of 4. Two cattle access problem sites found were EPS rated 3. The one site of inappropriate practices, a gabion wall that was separating from the bank, received an EPS rating of 3. See figure 40.

3.24 Cost of Remedial Measures

It is beyond the scope of this report to determine the cost of implementing the remedial measures suggested for each individual erosion problem site. However, by combining information on the number and design specifications of the recommended remedial measures with information on the costs and design specifications of recent reported streambank improvement projects, an estimate of the range of costs for implementing remedial measures is made.

The reported costs are for remedial measures on sites with EPS ratings of 3, 4 or 5. It is unlikely that these costs will apply to sites with EPS ratings of 1 or 2. Therefore, only the number of sites with EPS ratings of 3 or greater are considered.

This estimate does not take engineering design costs into consideration and assumes labour is performed for minimum wage. These conditions duplicate those under which the actual projects were conducted.

For erosion problem sites with EPS ratings of 3 or greater it is estimated the cost of implementing remedial measures is between $340,000 and $570,000.

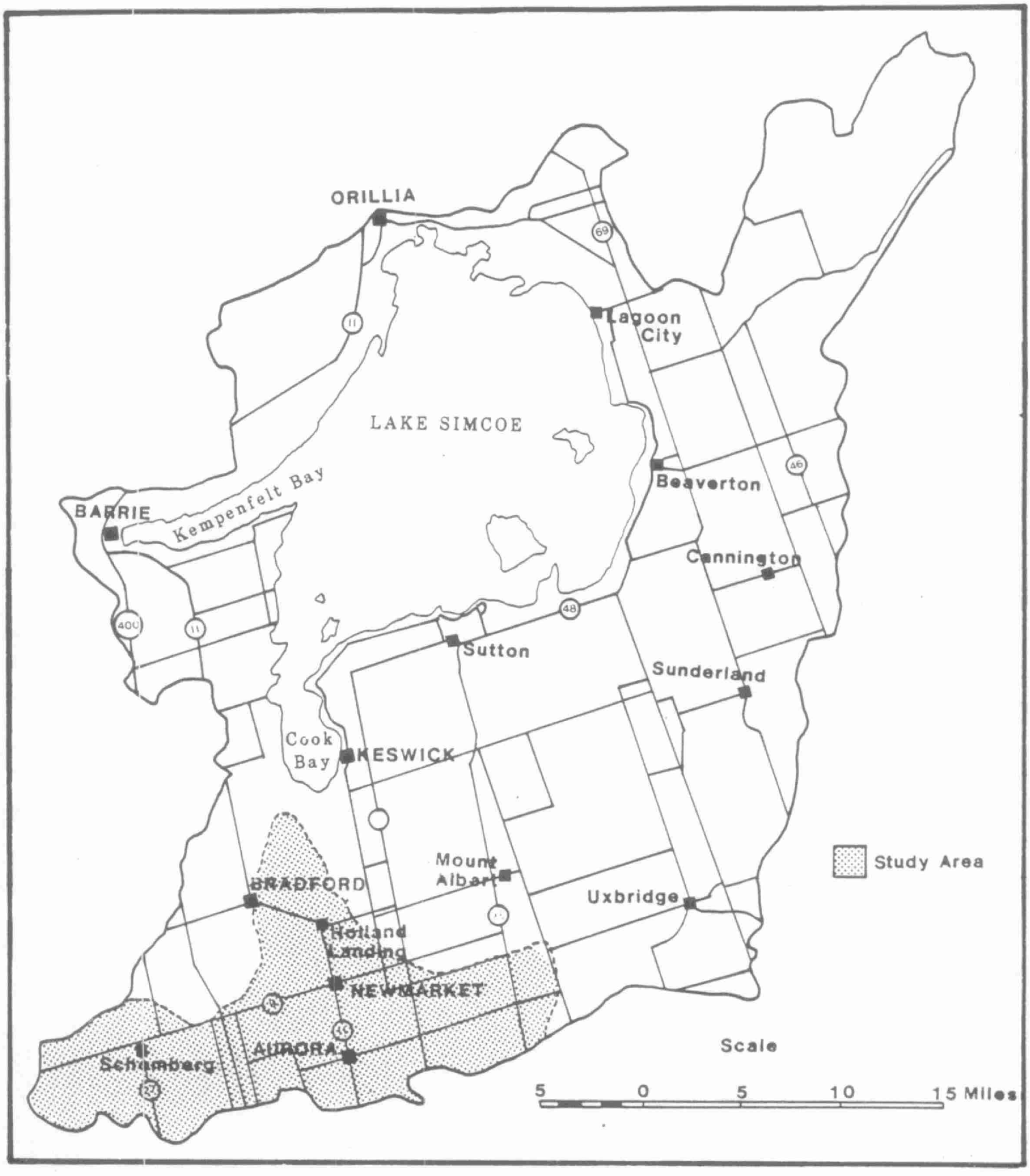


Figure 1 Location of Study Area

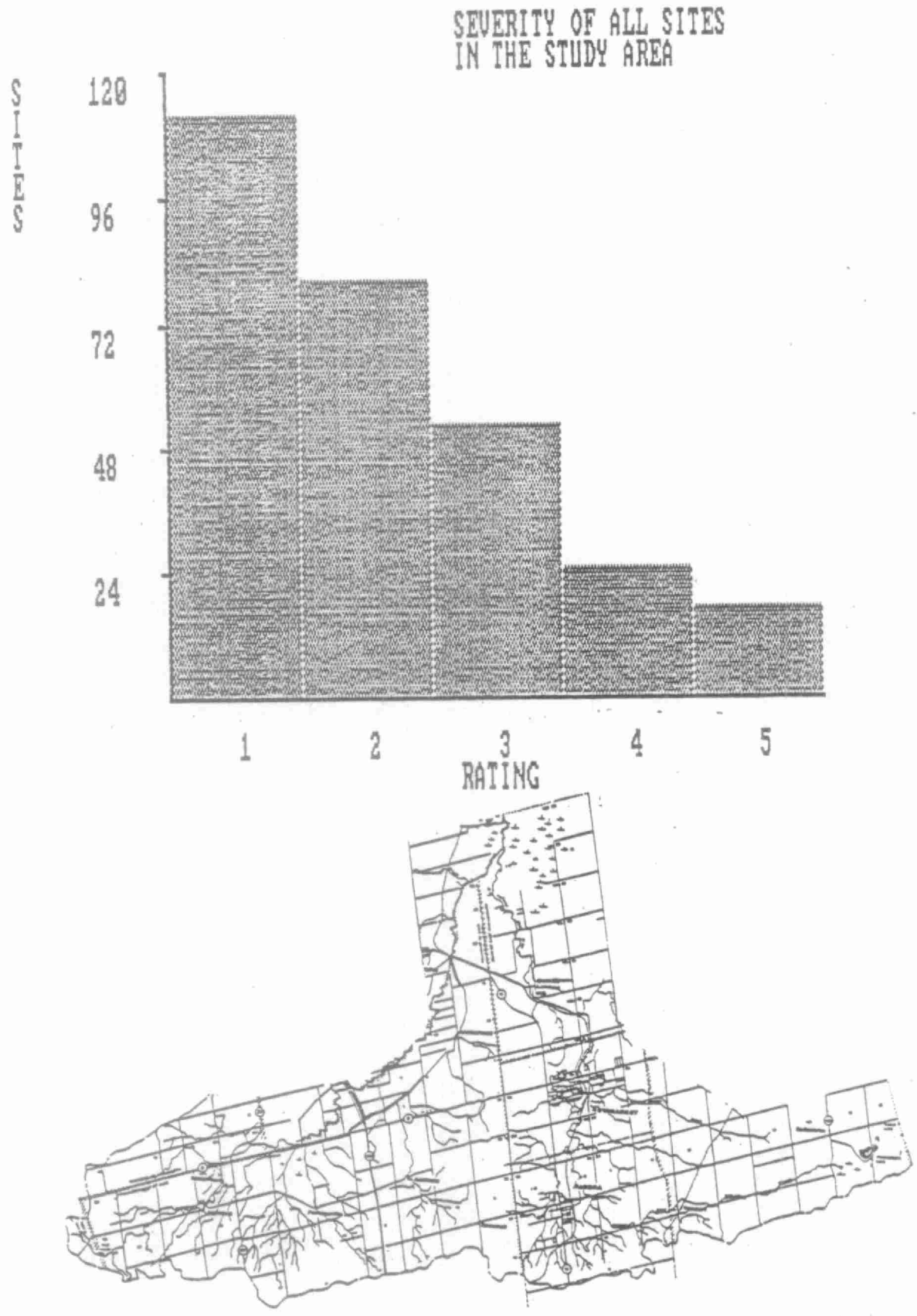


FIGURE 2. NUMBER OF SITES/RATING

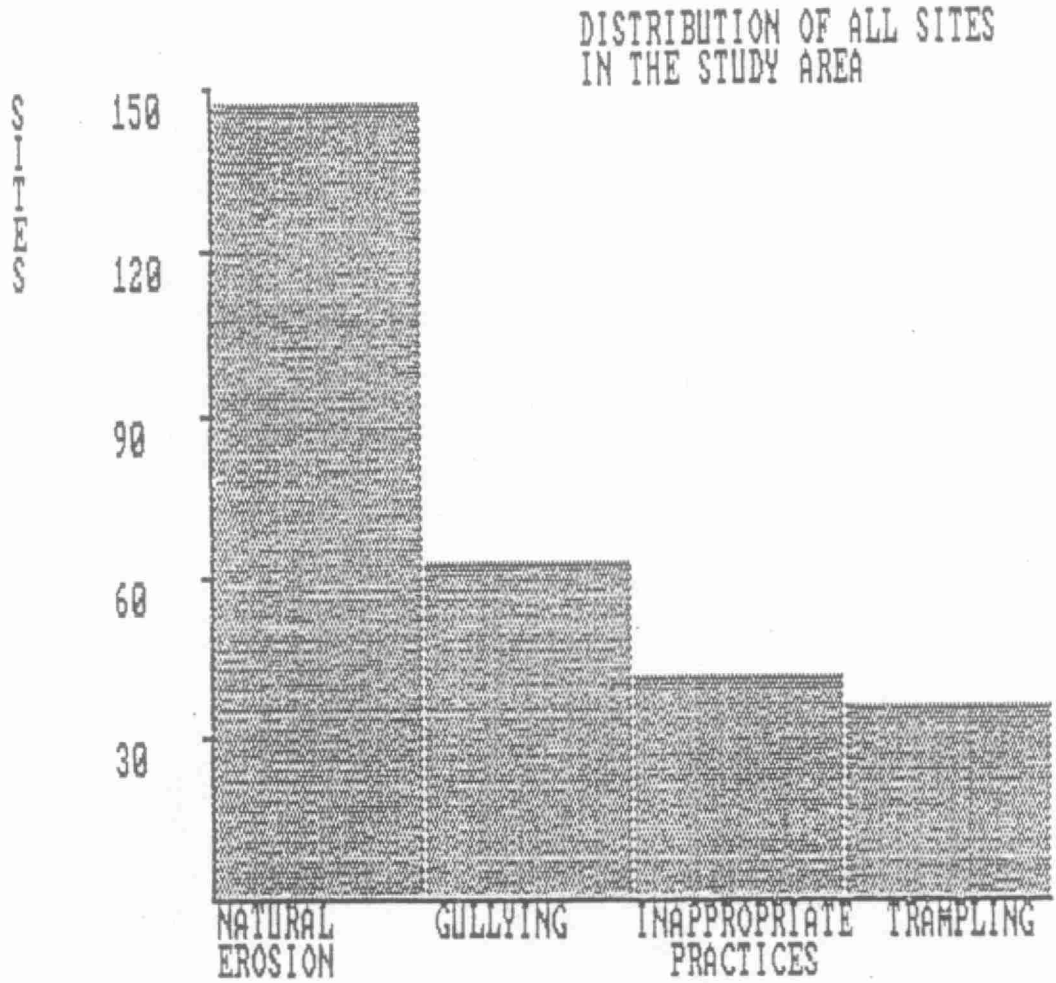
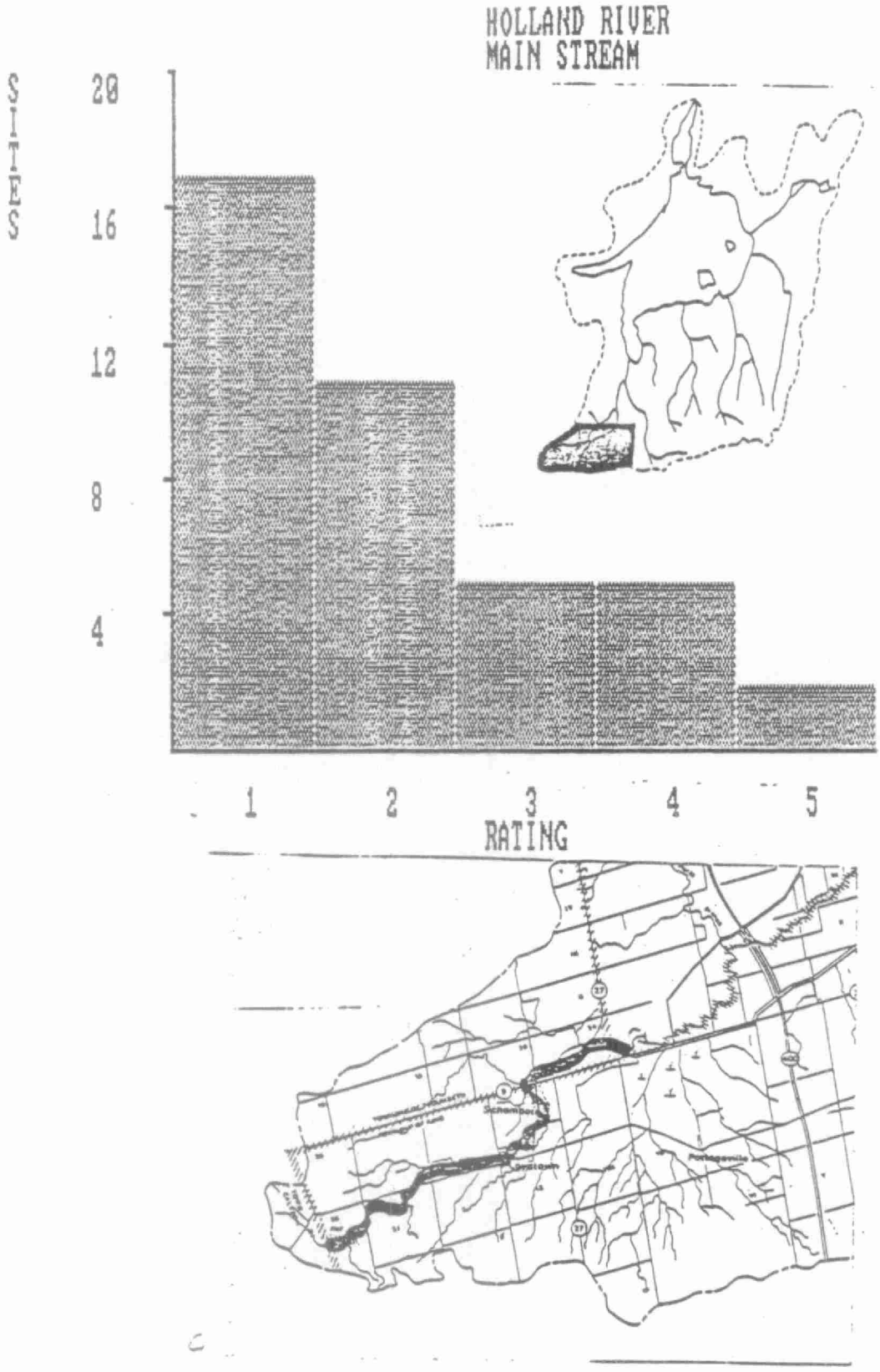


FIGURE 3. NUMBER OF SITES/TYPE



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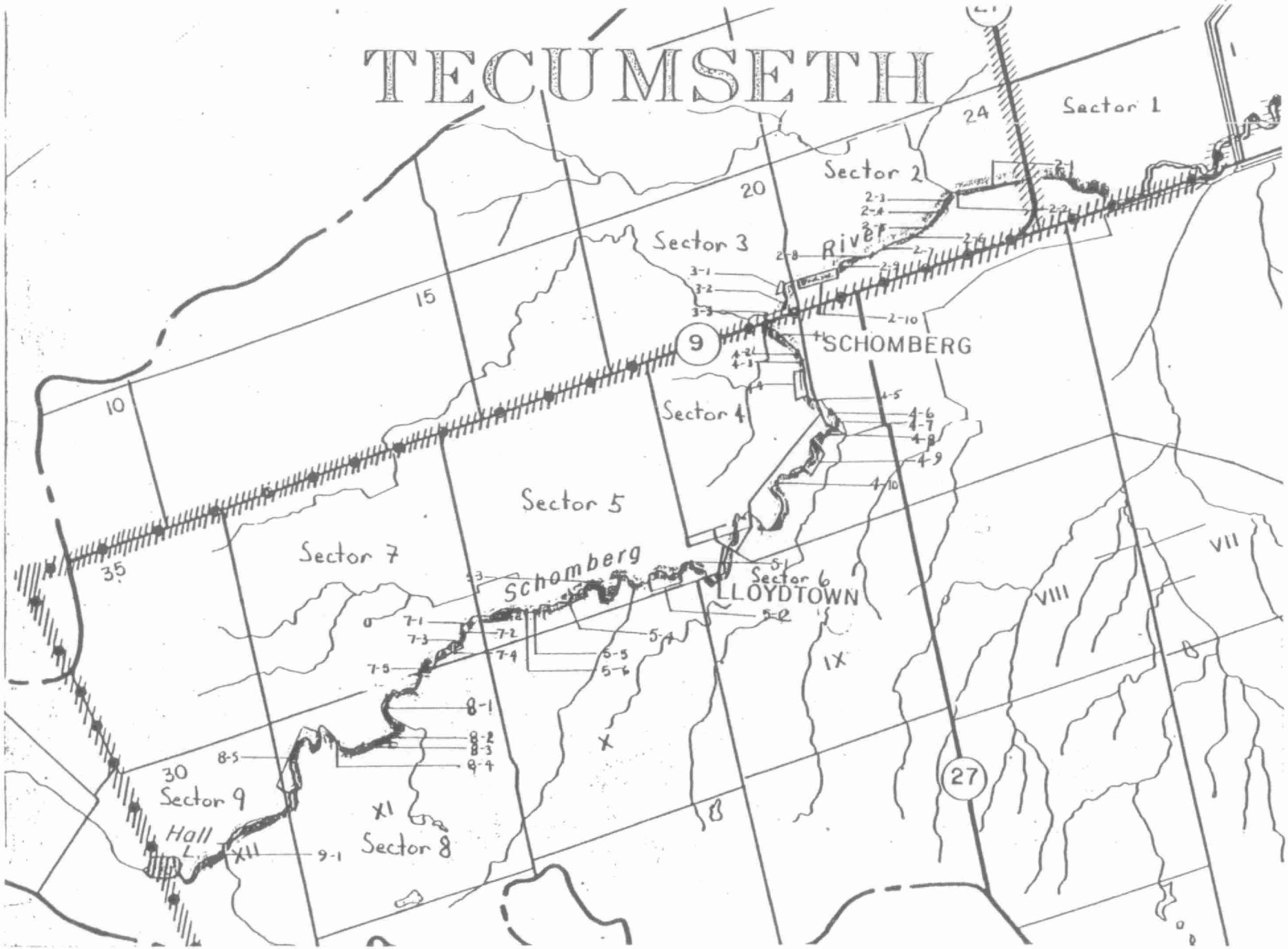
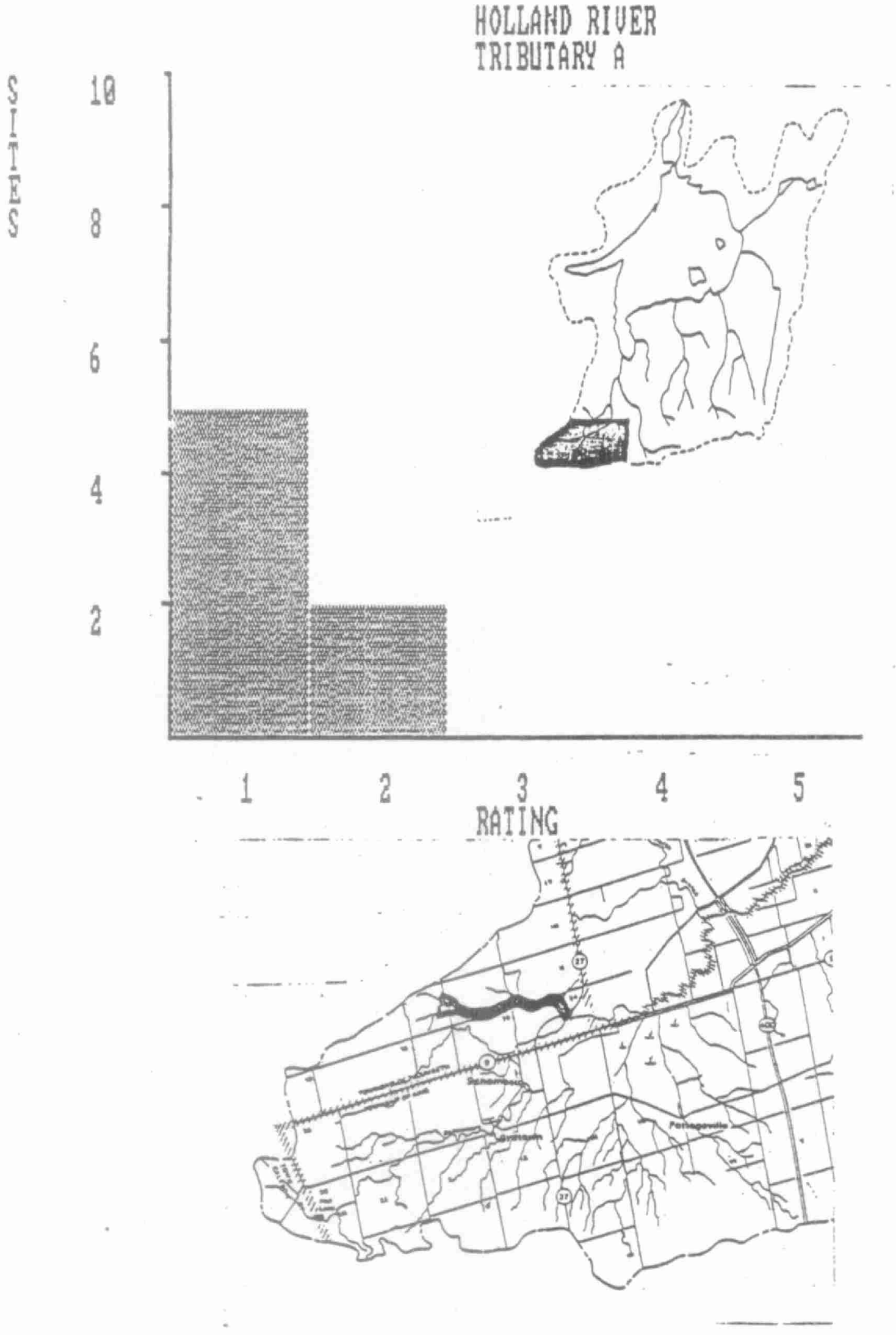


FIGURE 5. LOCATION OF SITES HOLLAND RIVER MAIN STREAM



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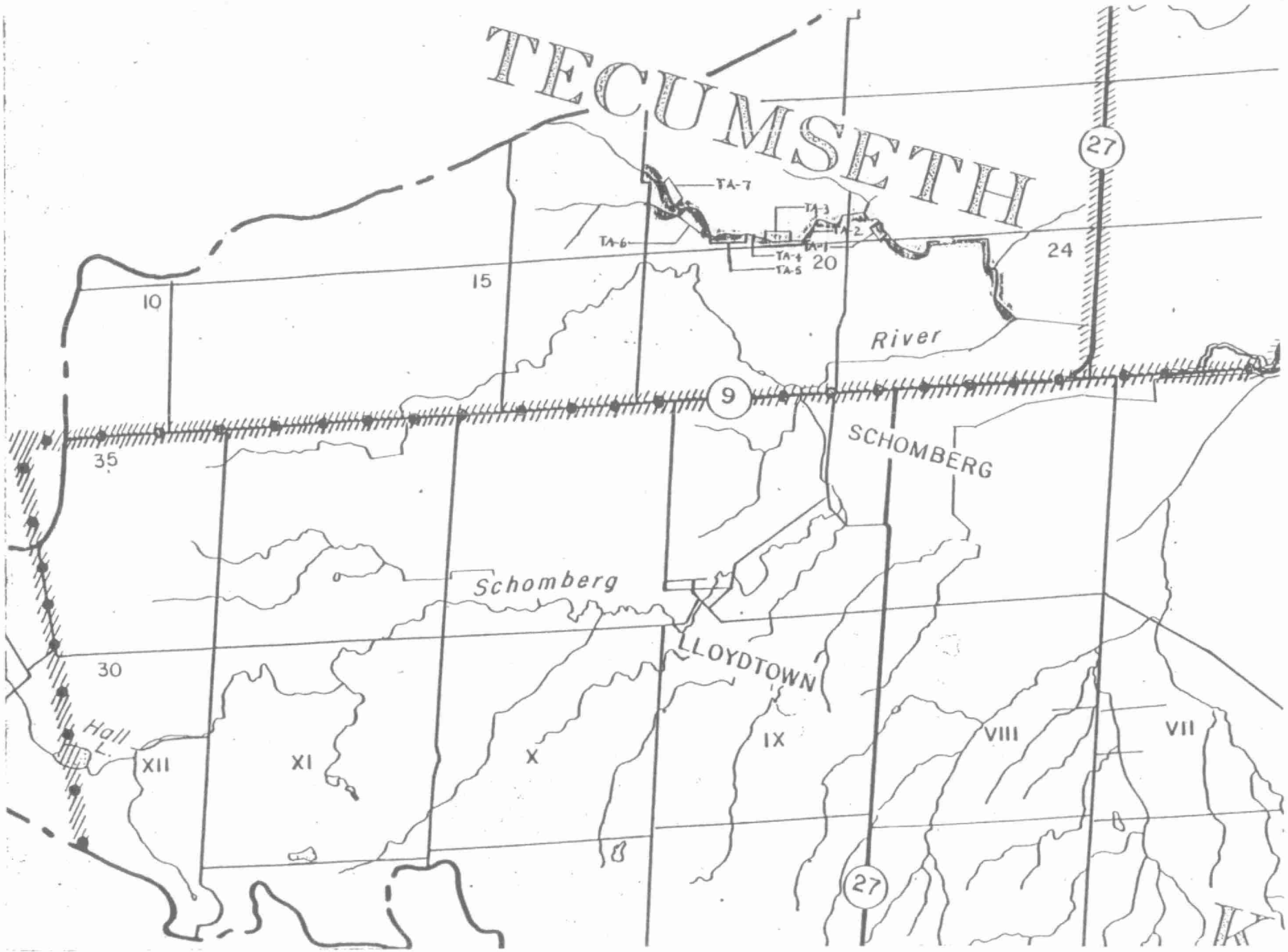
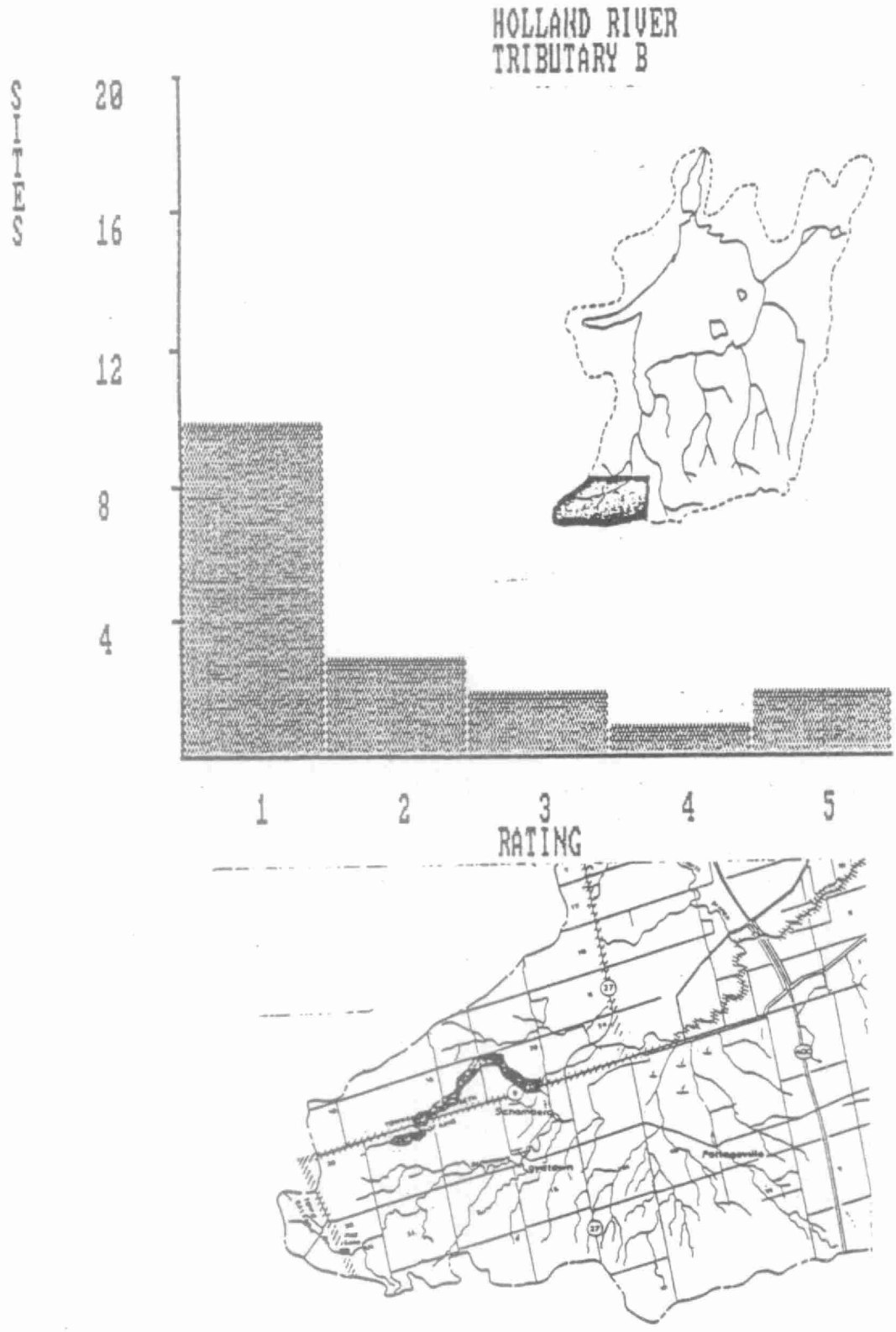


FIGURE 7. LOCATION OF SITES HOLLAND RIVER TRIBUTARY A



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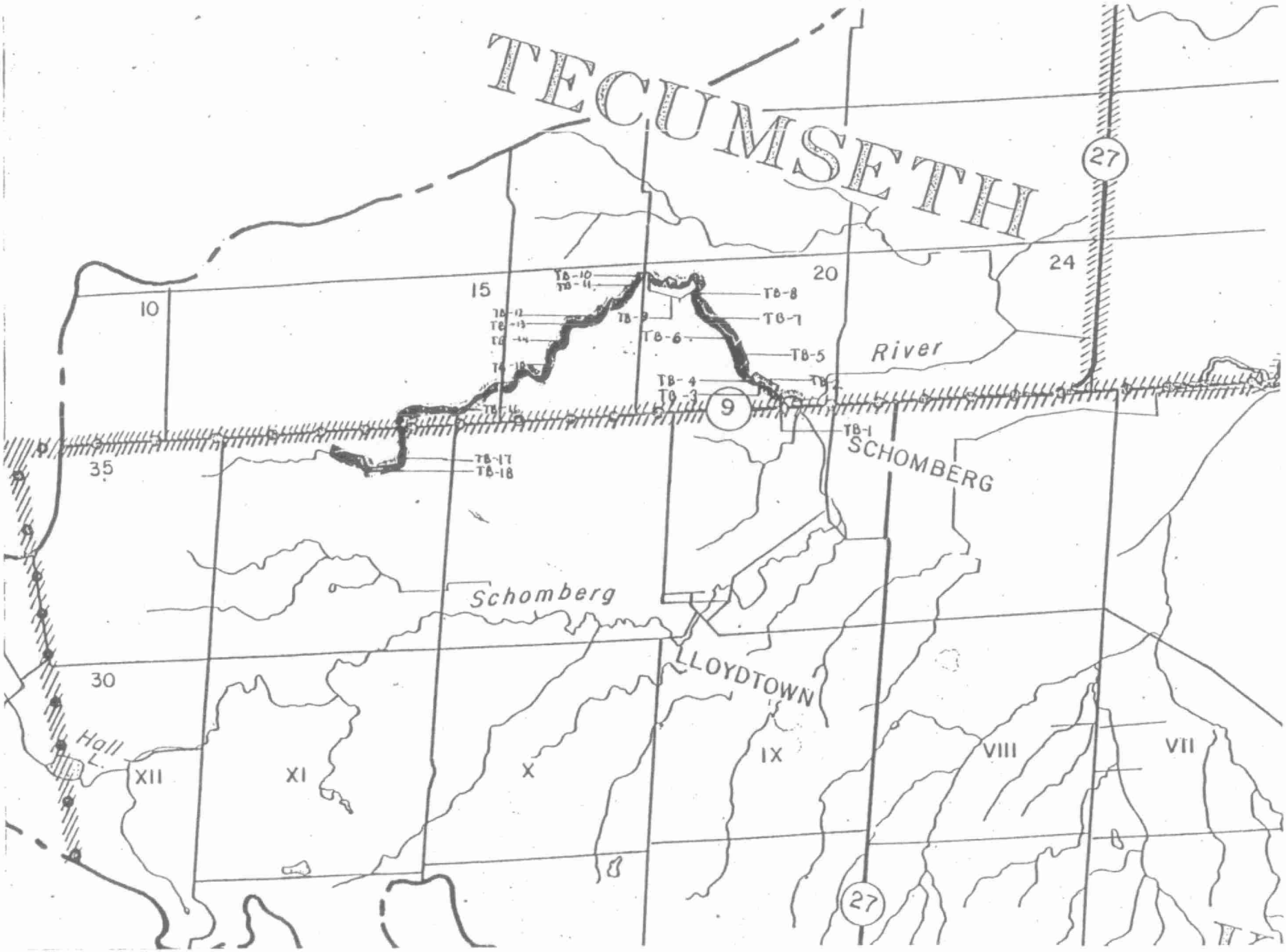
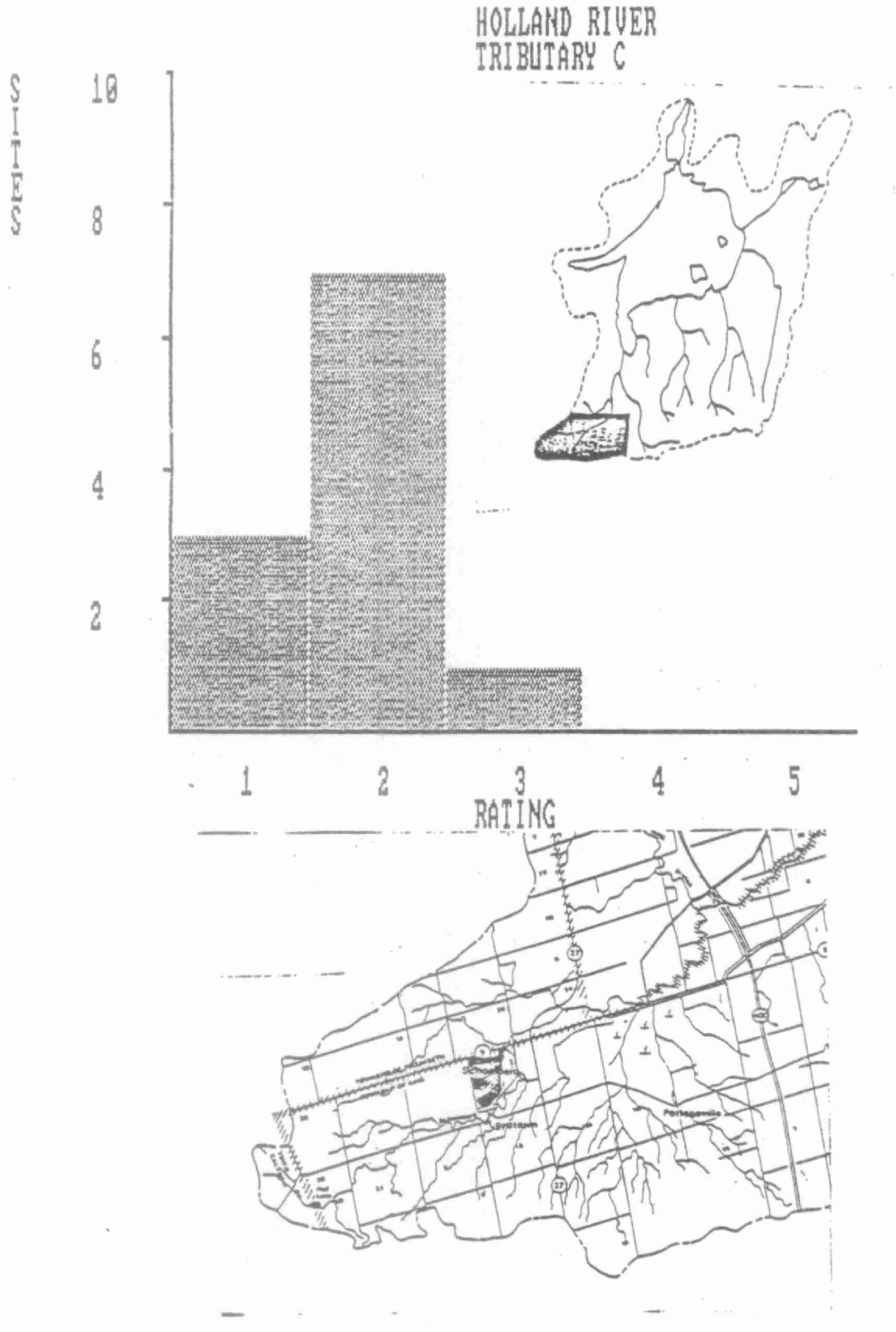


FIGURE 9. LOCATION OF SITES HOLLAND RIVER TRIBUTARY B



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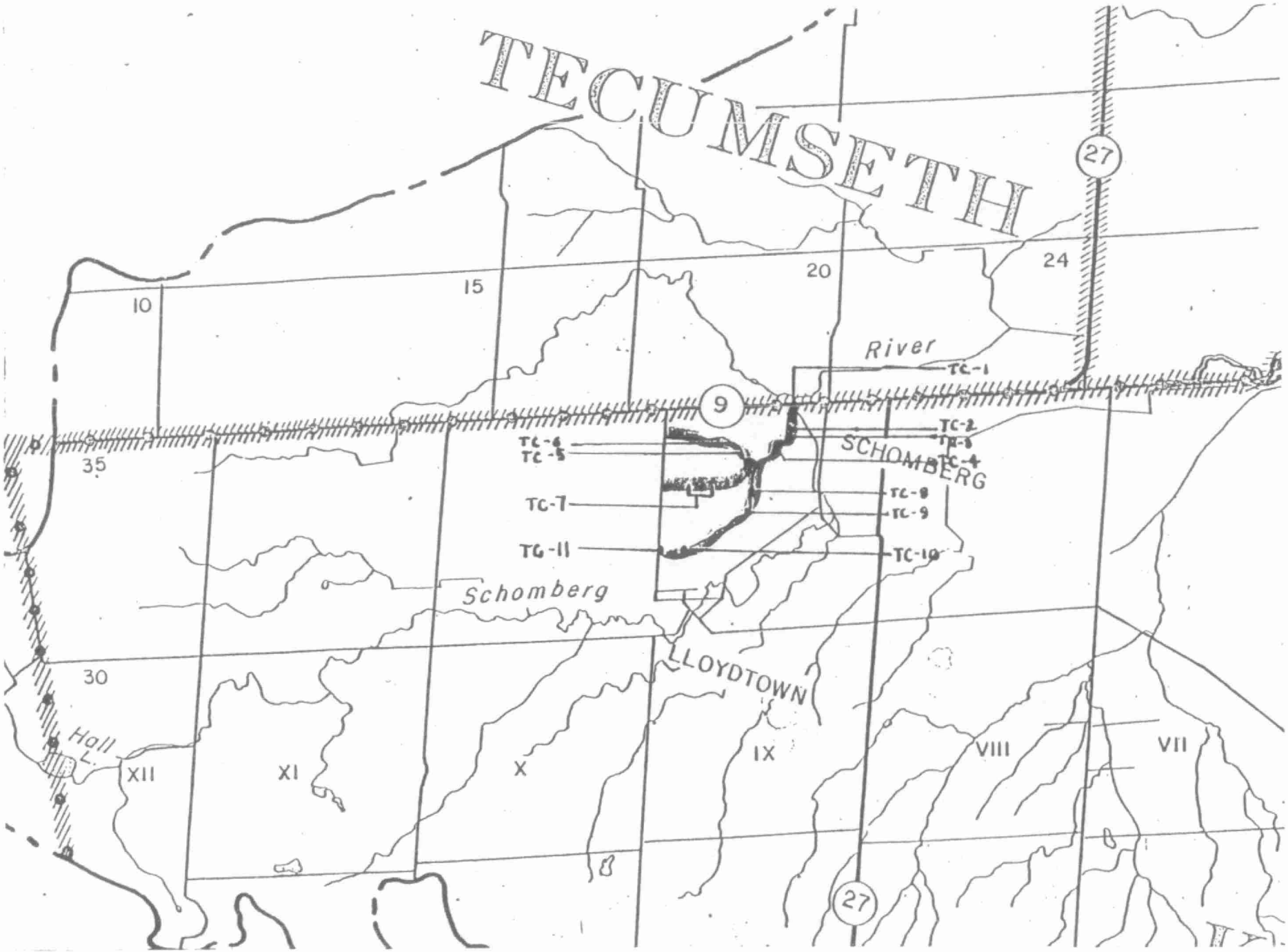
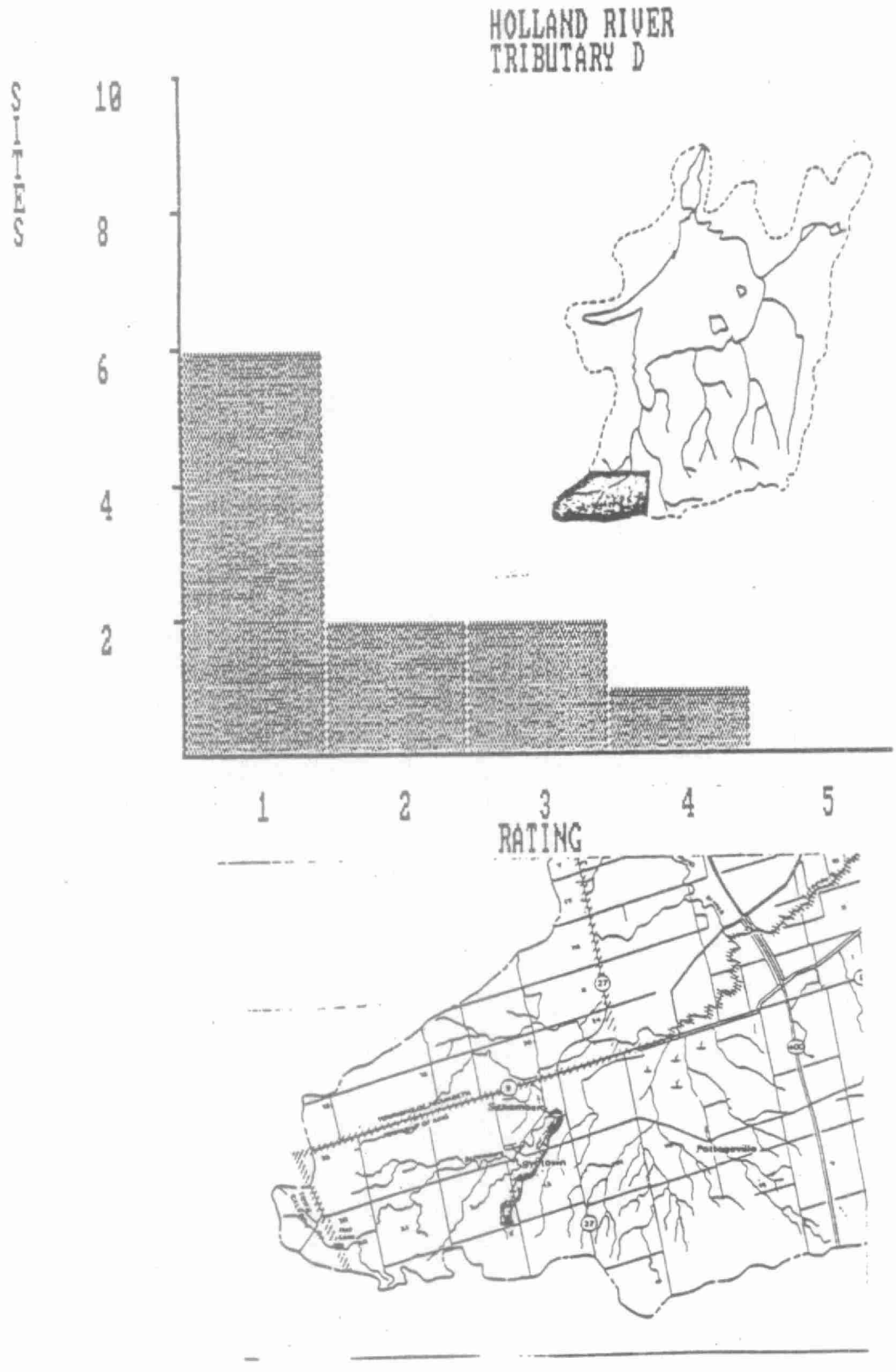


FIGURE 11. LOCATION OF SITES HOLLAND RIVER TRIBUTARY C



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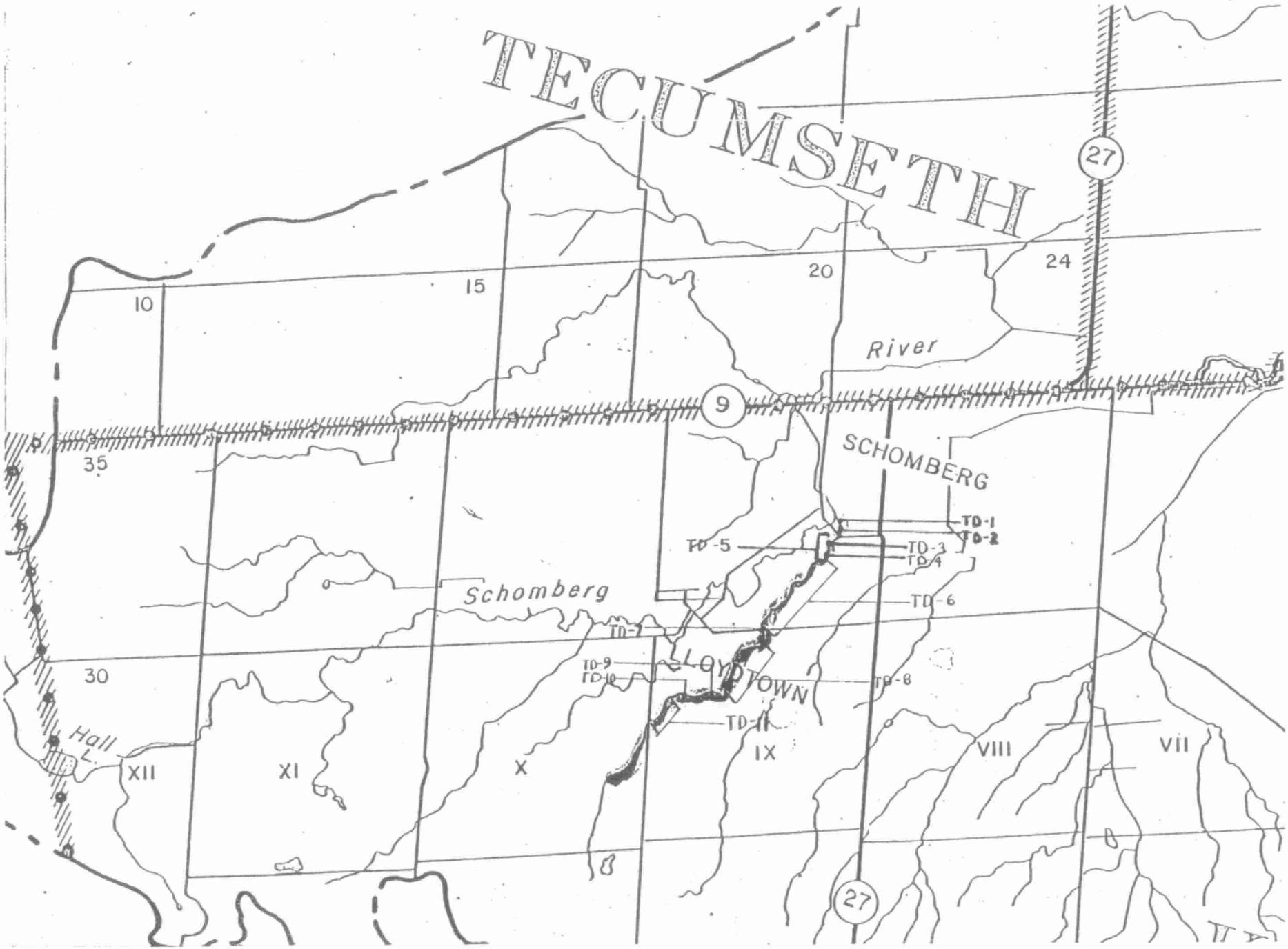
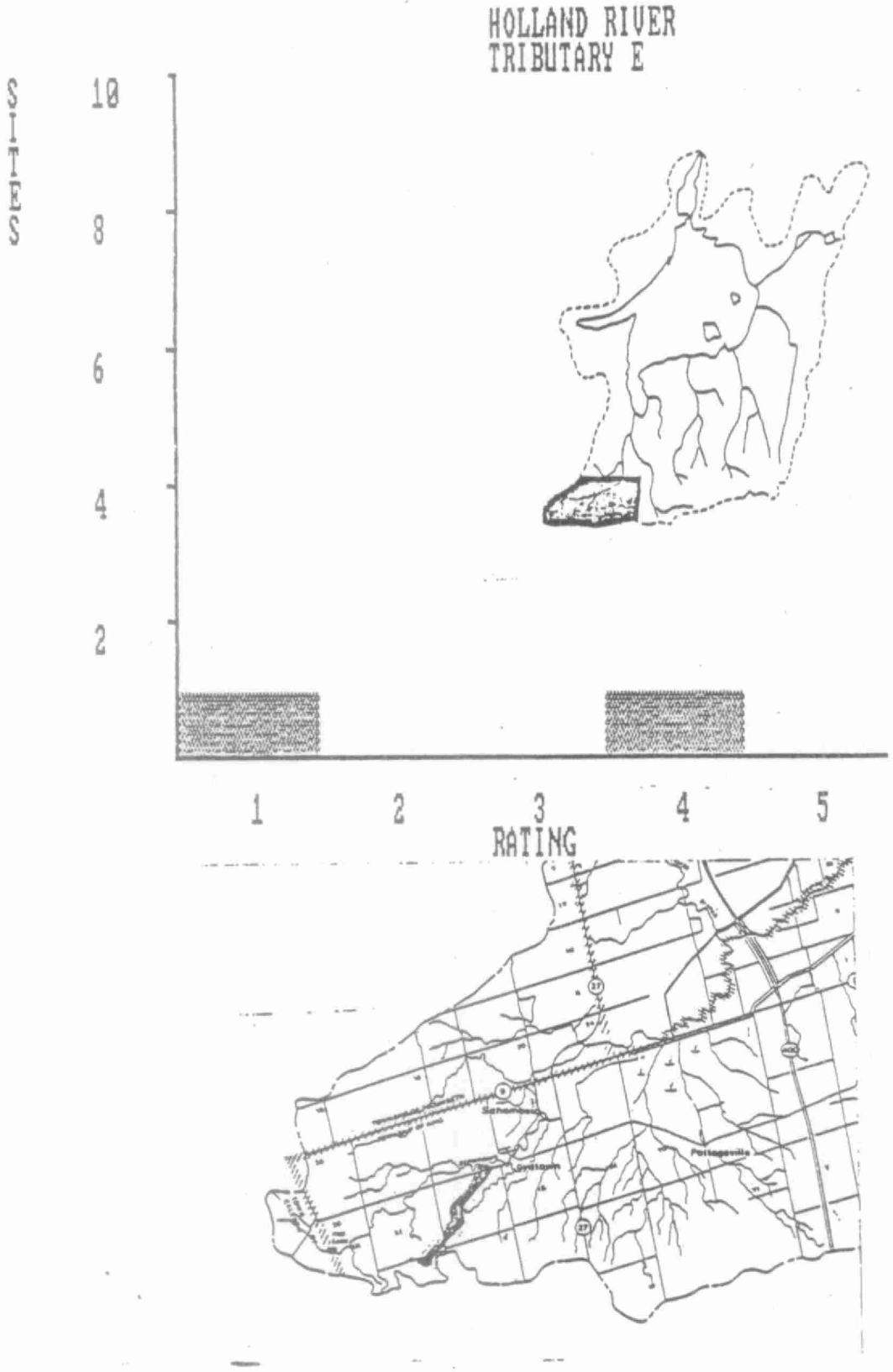


FIGURE 13. LOCATION OF SITES HOLLAND RIVER TRIBUTARY D



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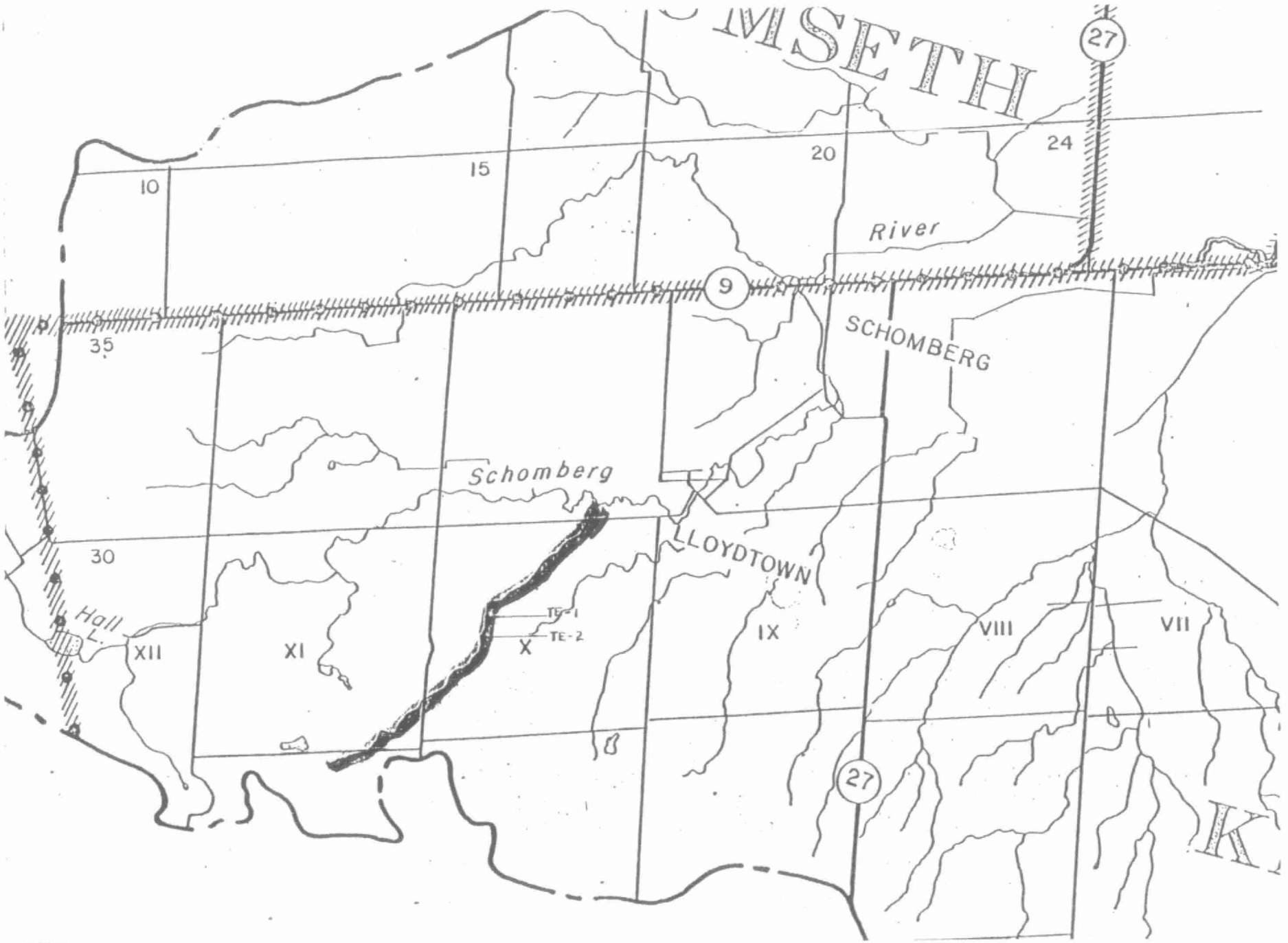
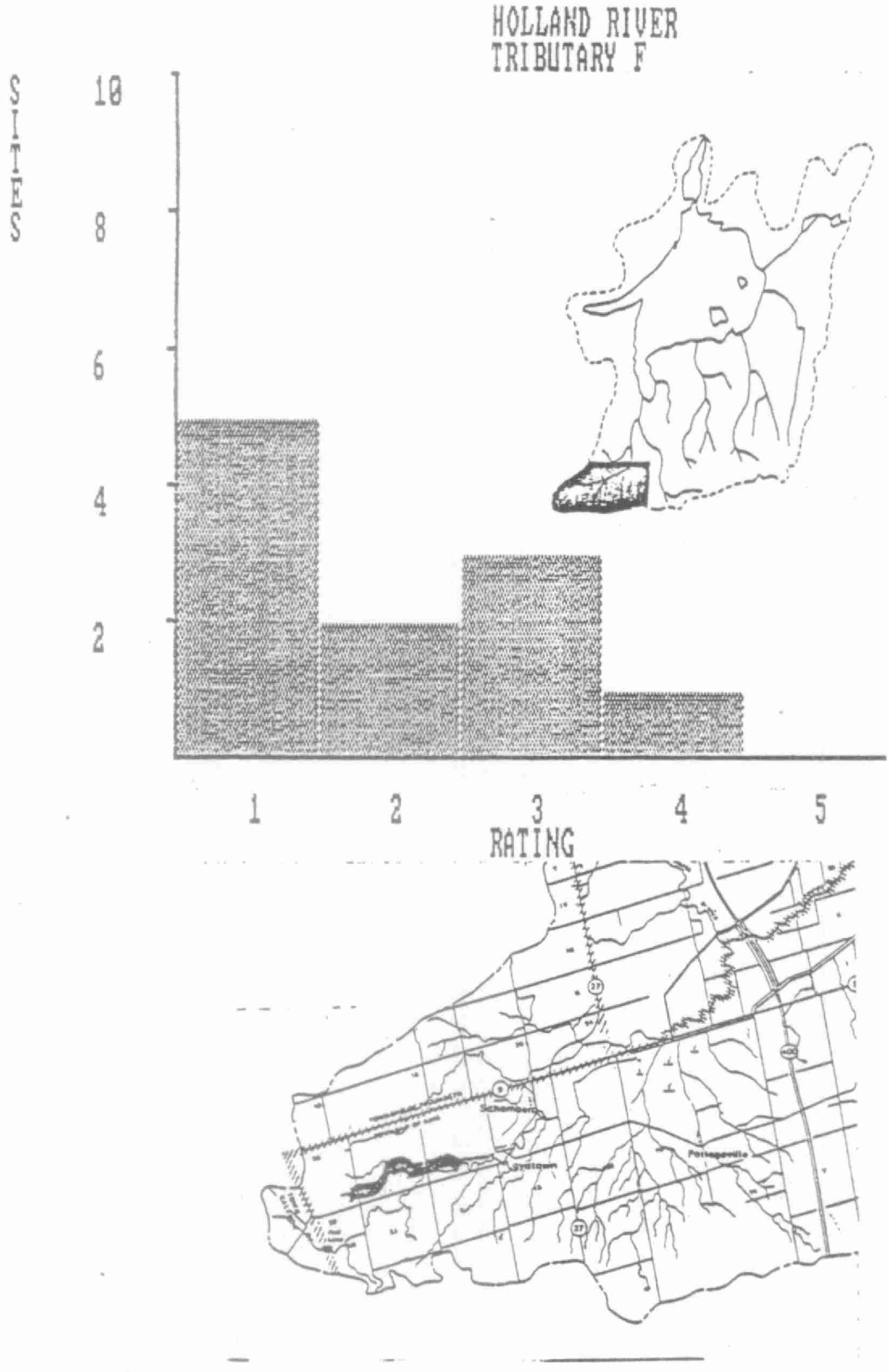


FIGURE 15. LOCATION OF SITES HOLLAND RIVER TRIBUTARY E



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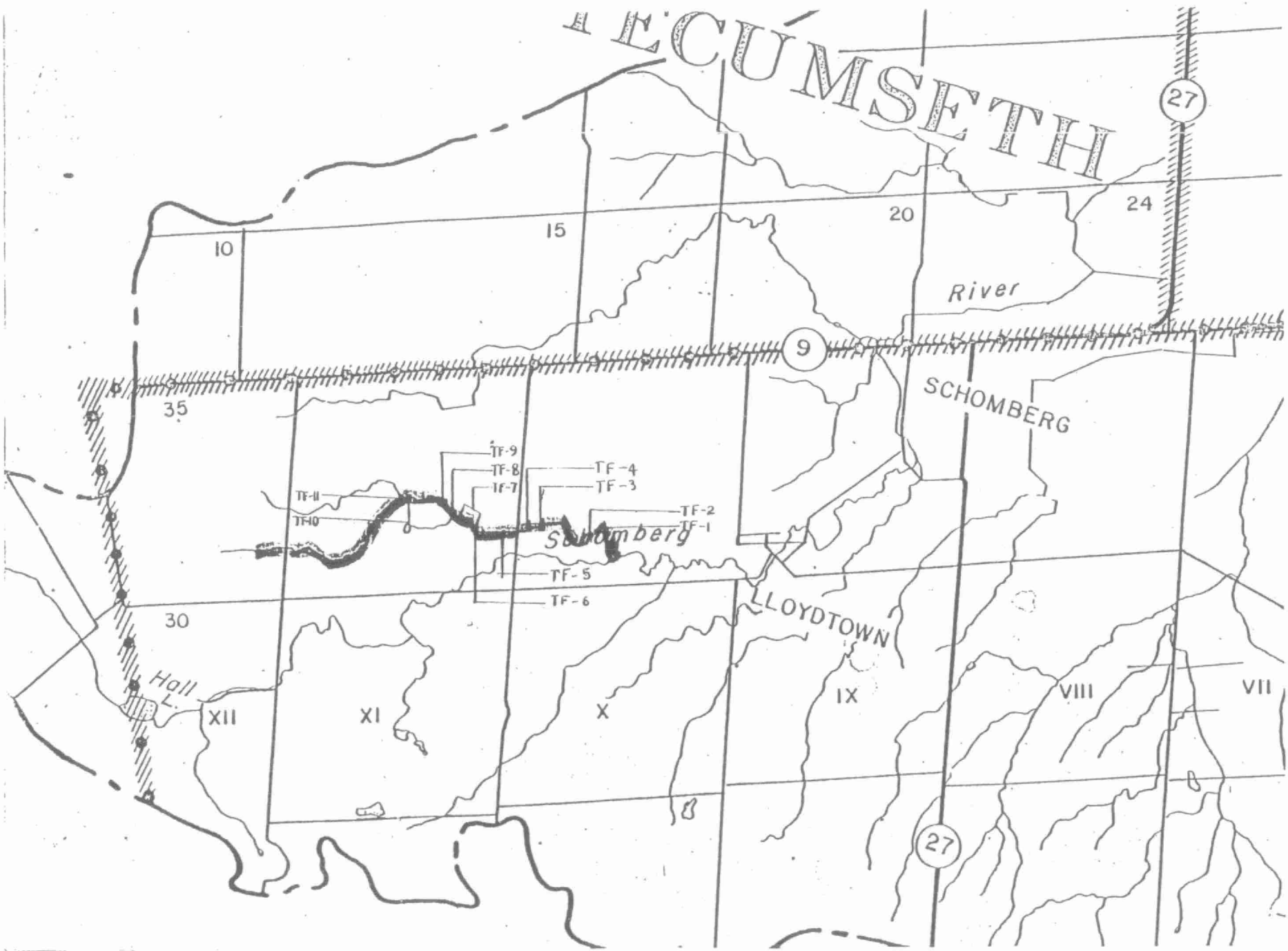
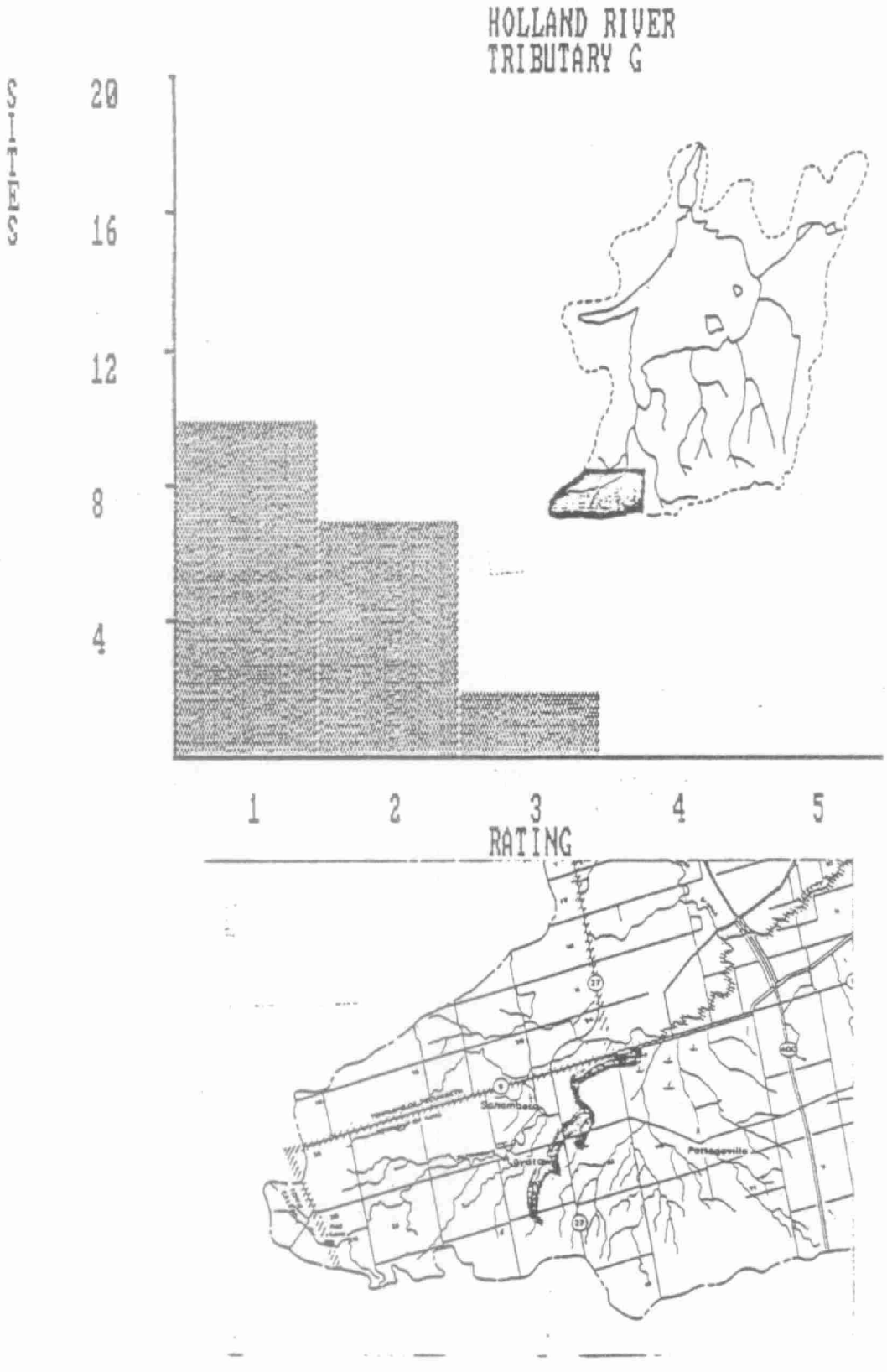


FIGURE 17. LOCATION OF SITES HOLLAND RIVER TRIBUTARY F



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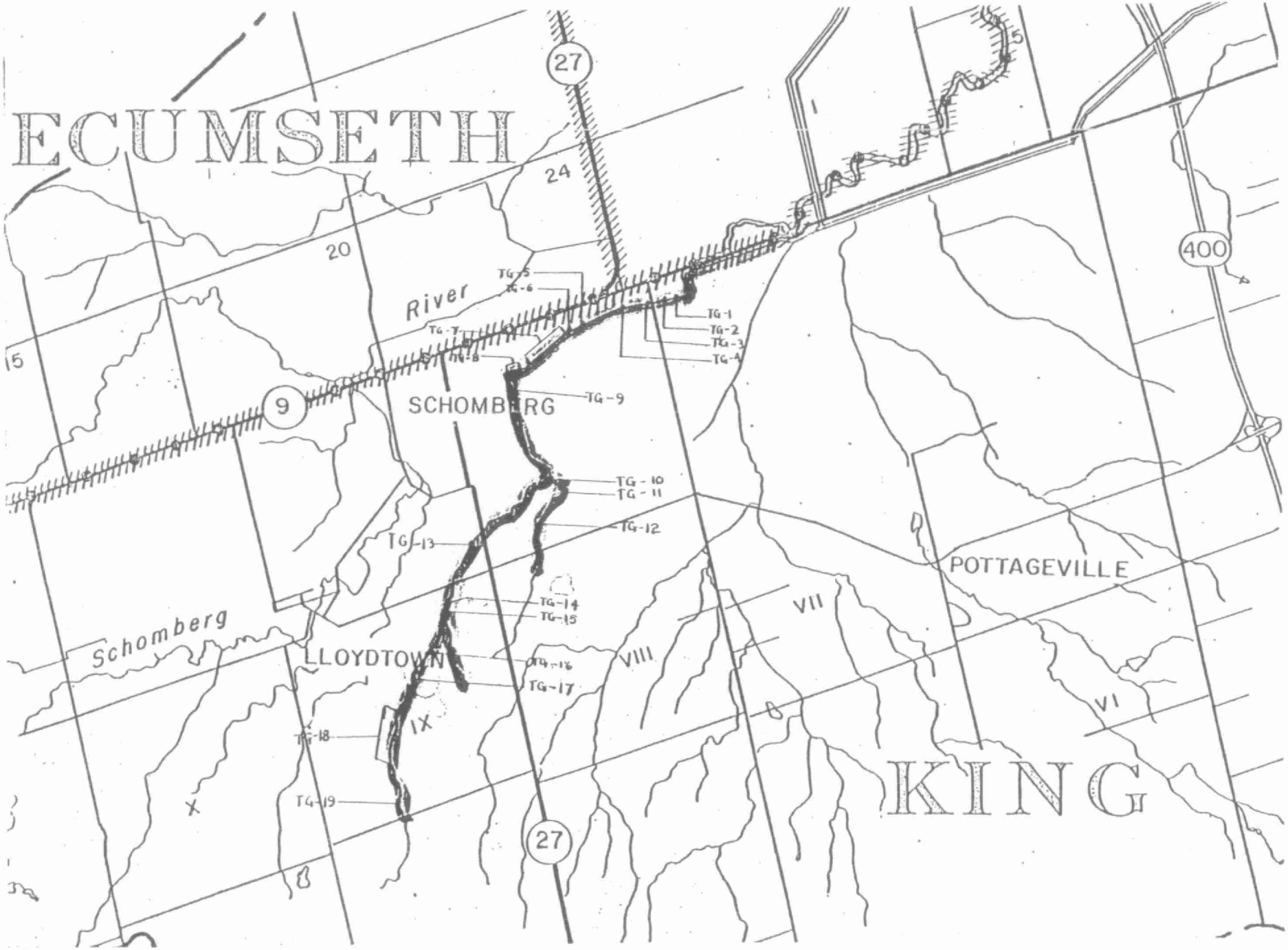
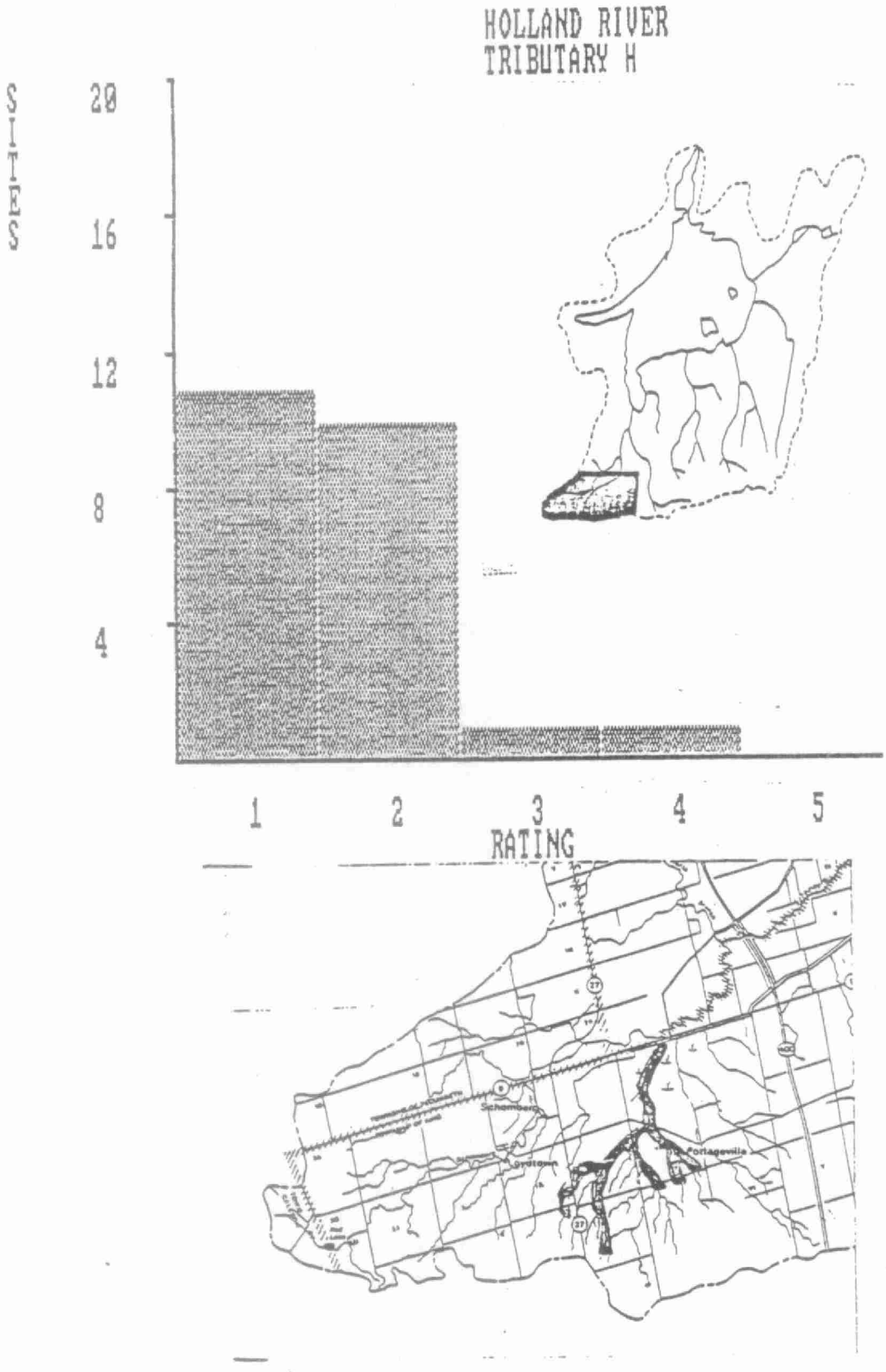


FIGURE 19. LOCATION OF SITES HOLLAND RIVER TRIBUTARY G



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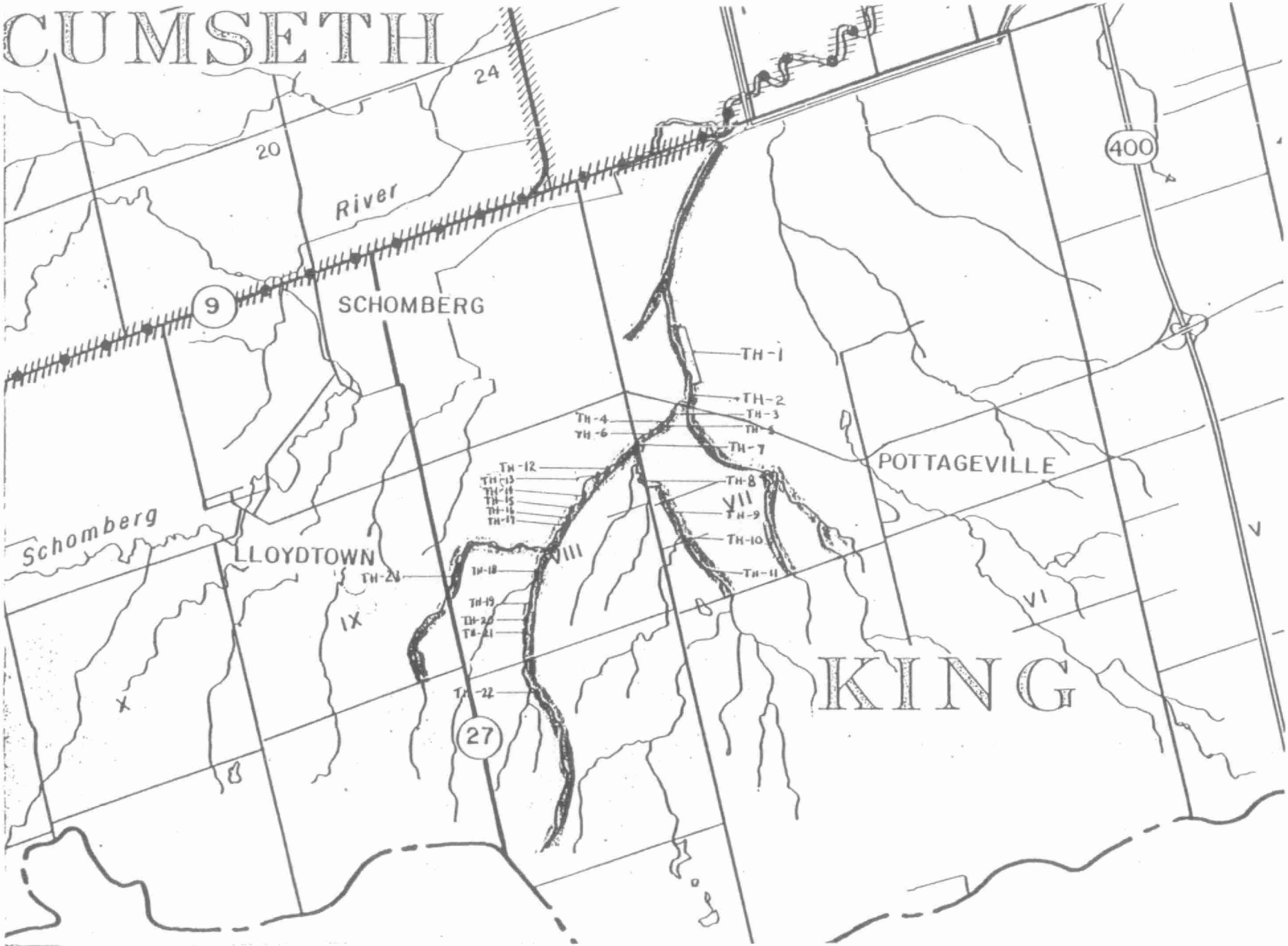
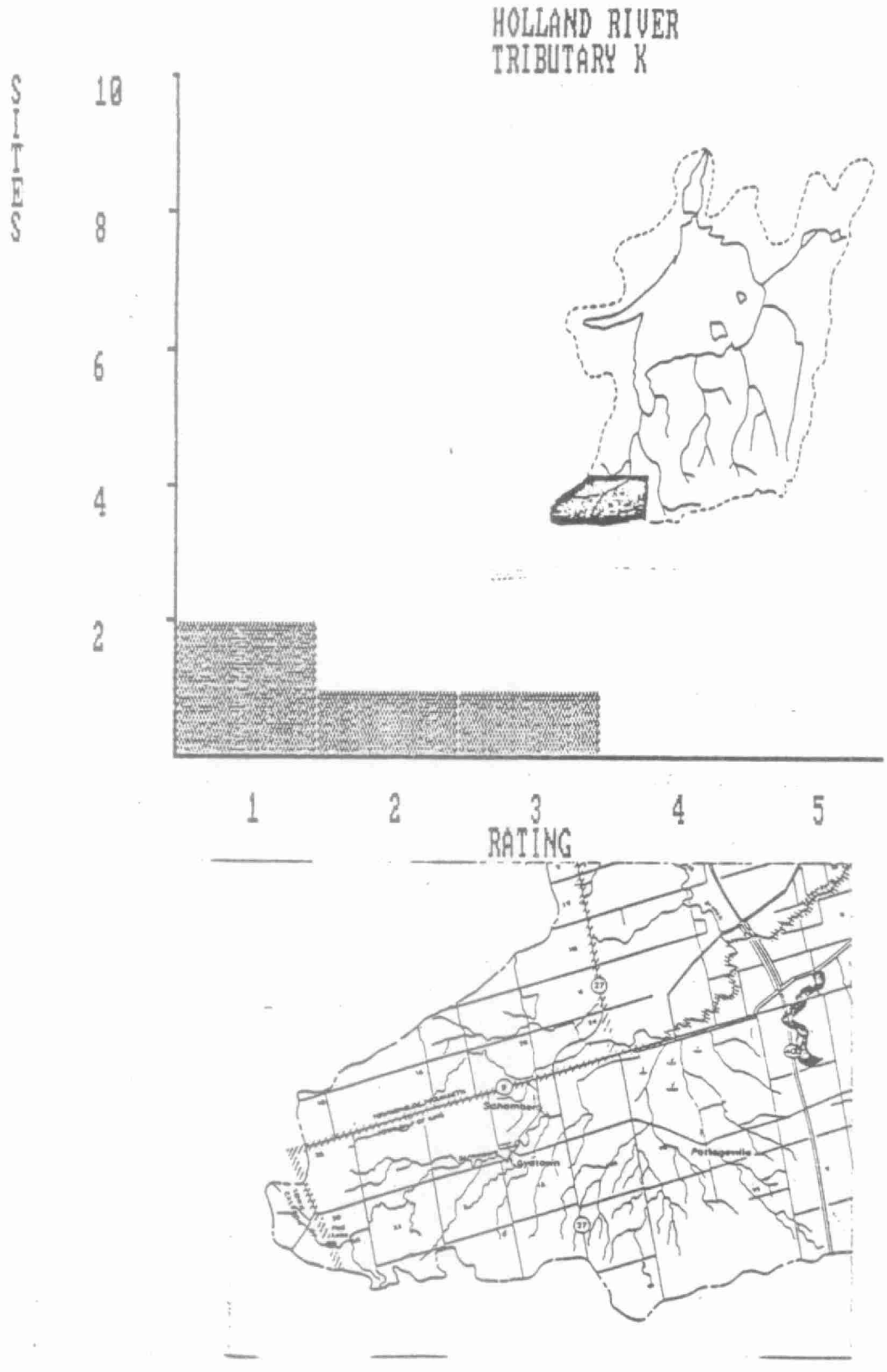


FIGURE 21. LOCATION OF SITES HOLLAND RIVER TRIBUTARY H



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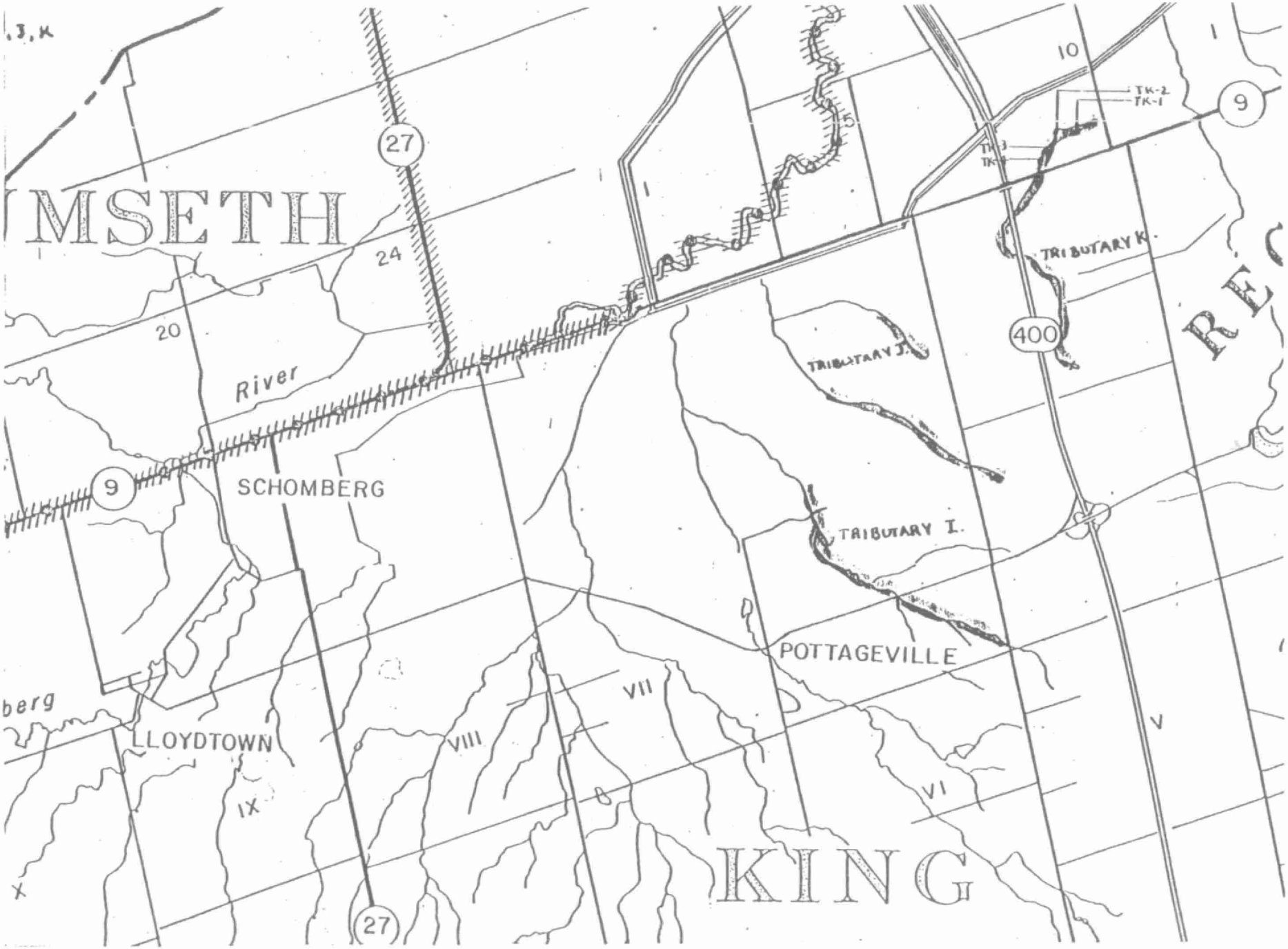


FIGURE 23. LOCATION OF SITES HOLLAND RIVER TRIBUTARY K

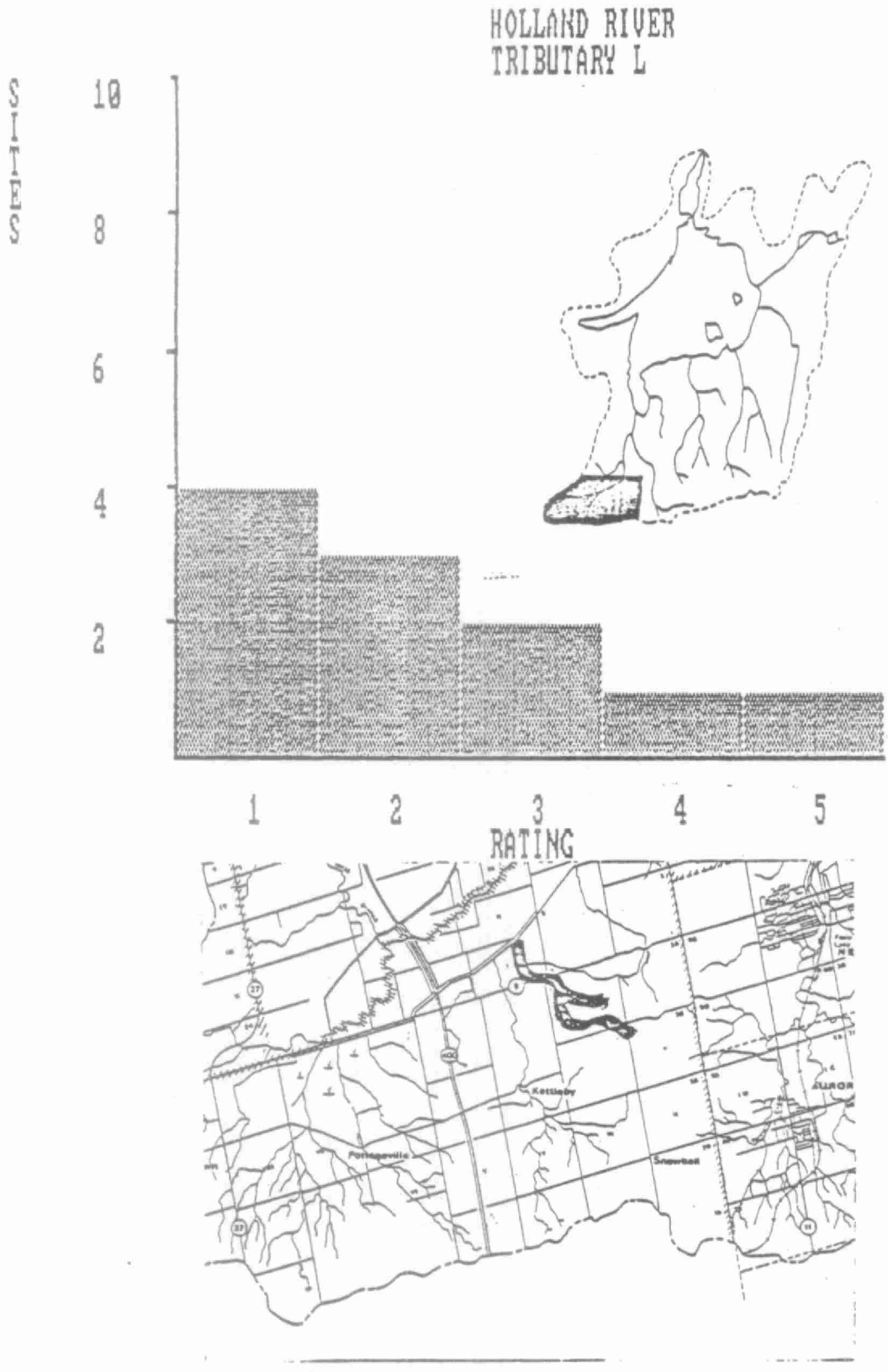
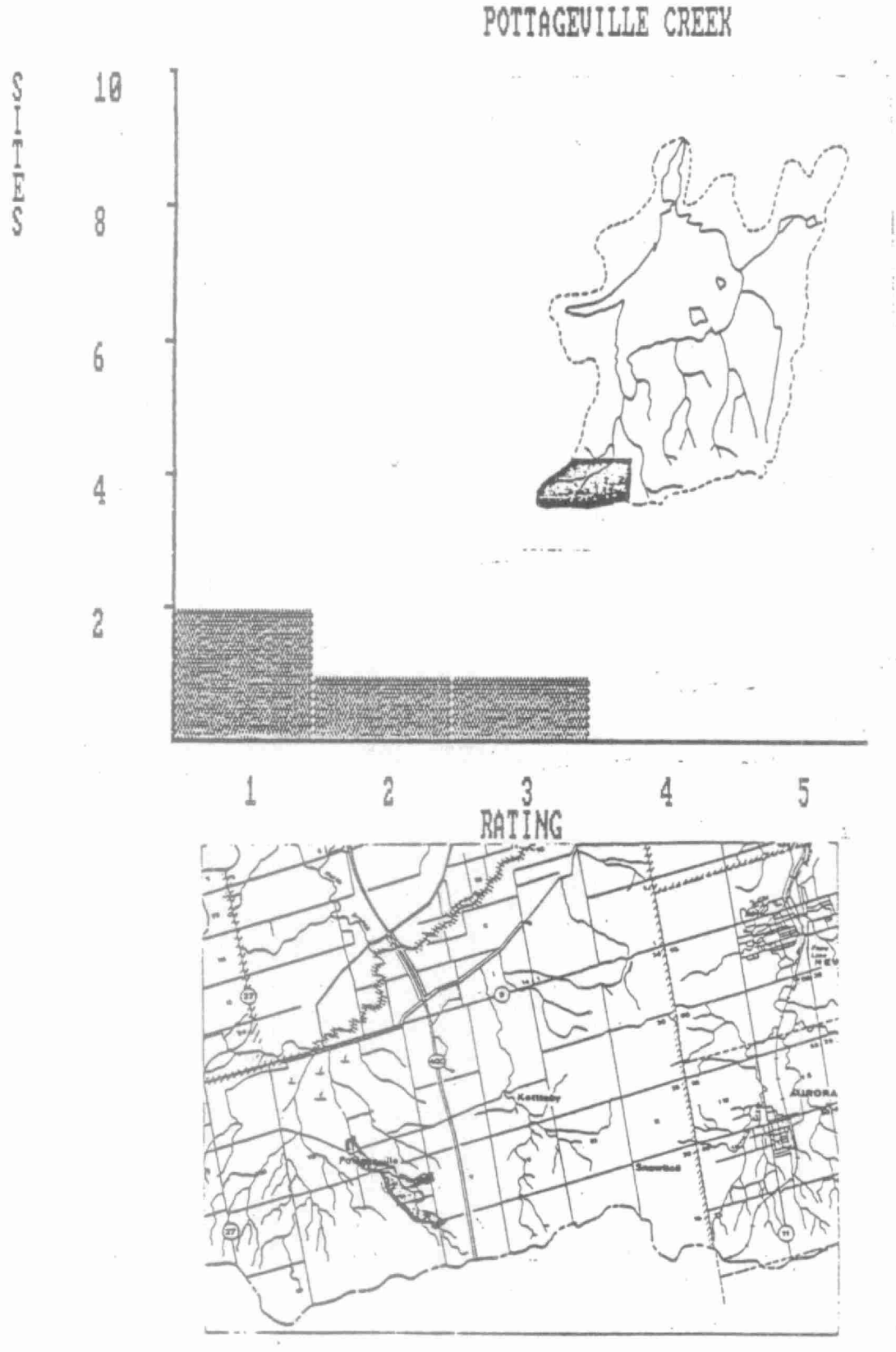


FIGURE 24. NUMBER OF SITES/RATING

FIGURE 25. LOCATION OF SITES HOLLAND RIVER TRIBUTARY L



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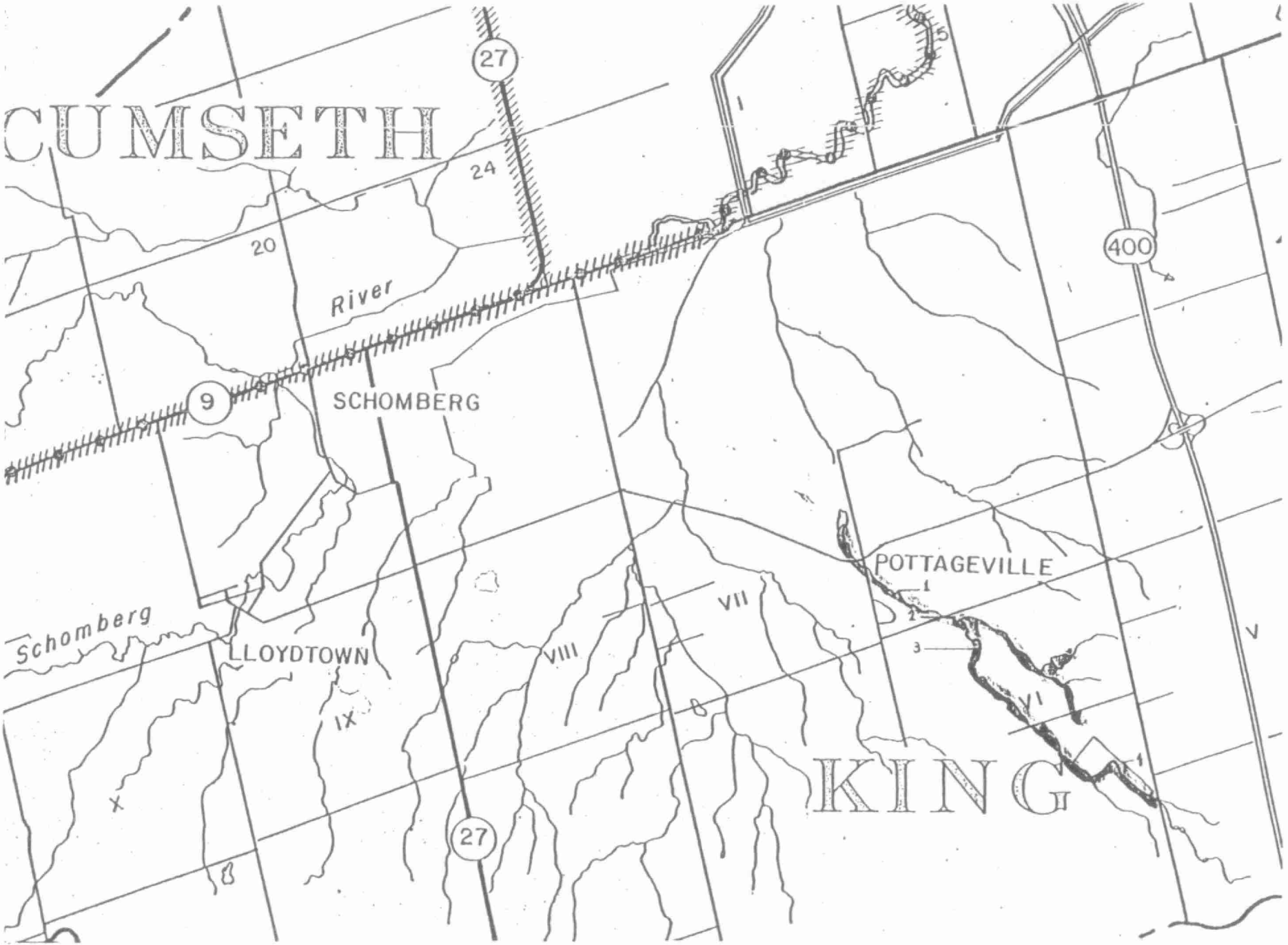
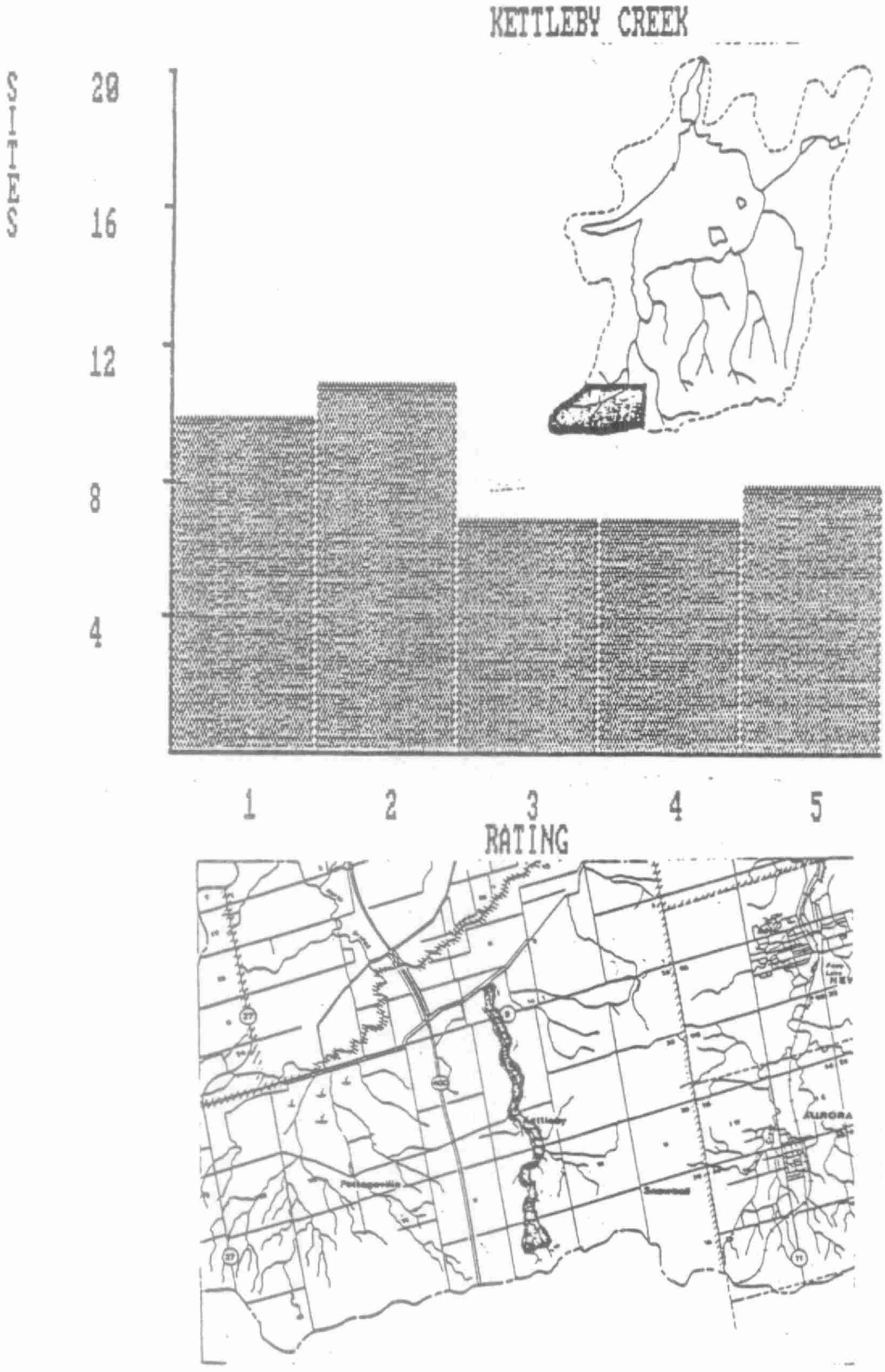


FIGURE 27. LOCATION OF SITES POTTAGEVILLE CREEK



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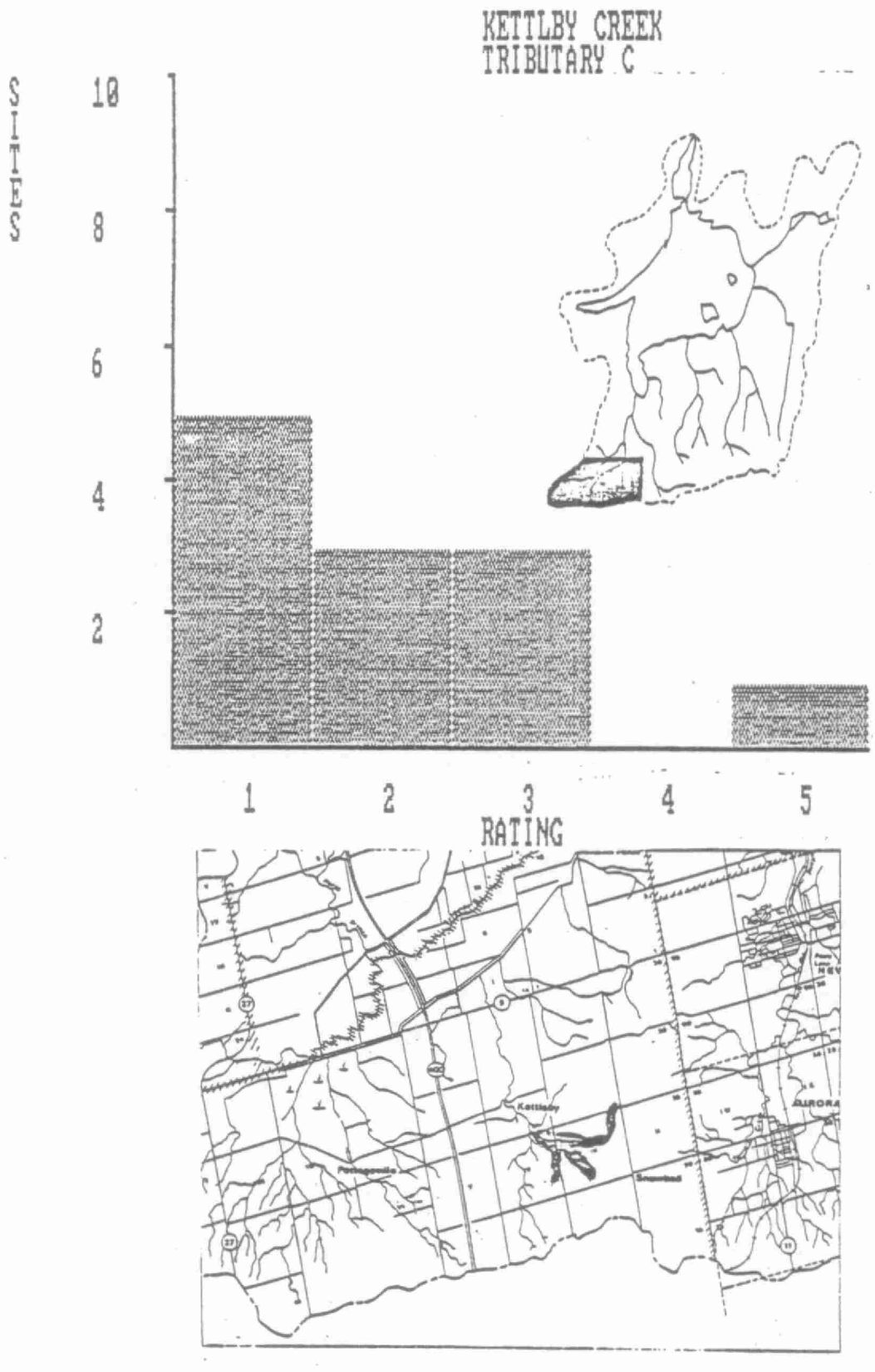
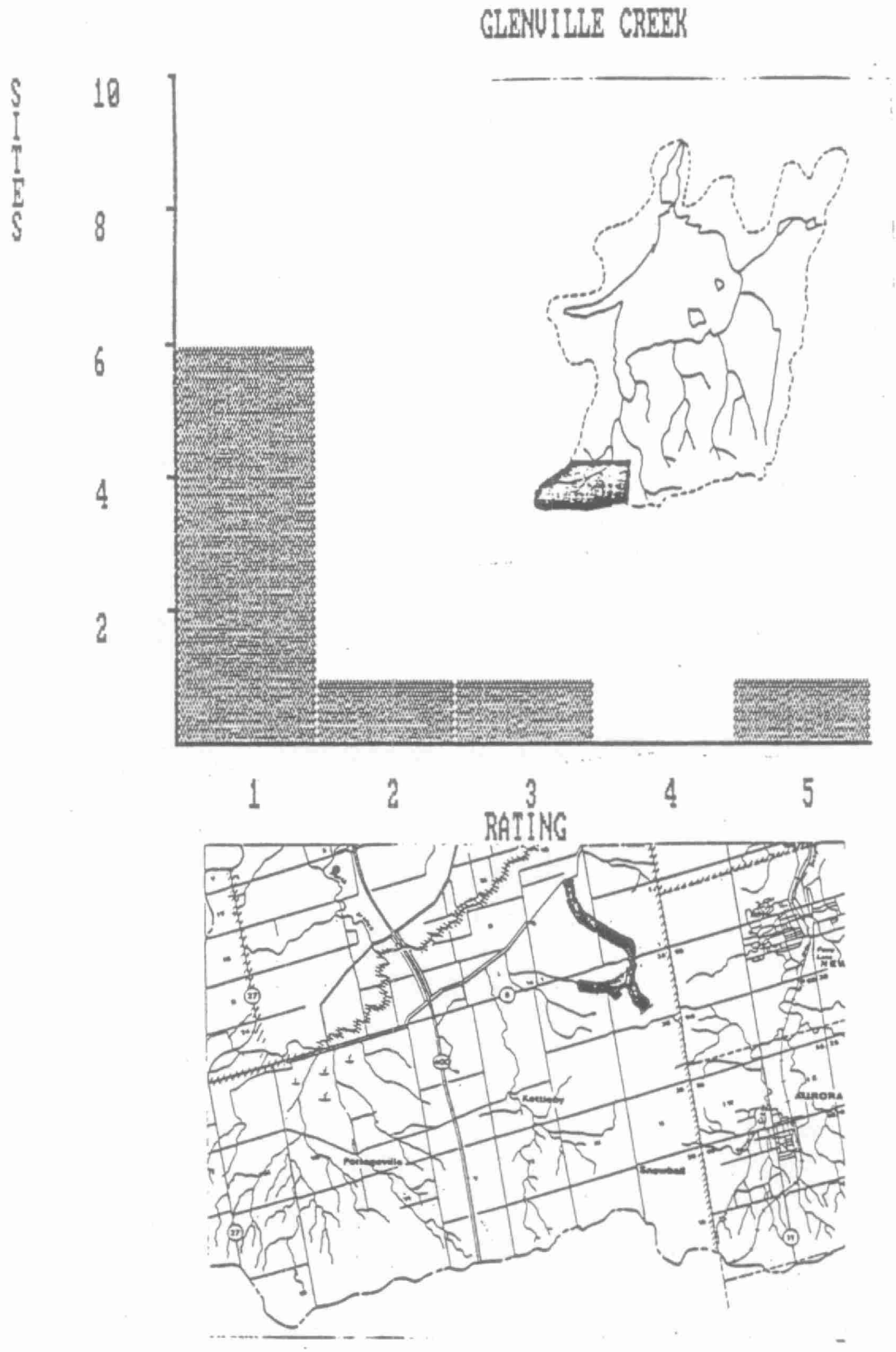


FIGURE 29. NUMBER OF SITES/RATING

FIGURE 30. LOCATION OF SITES KETTLEBY CREEK



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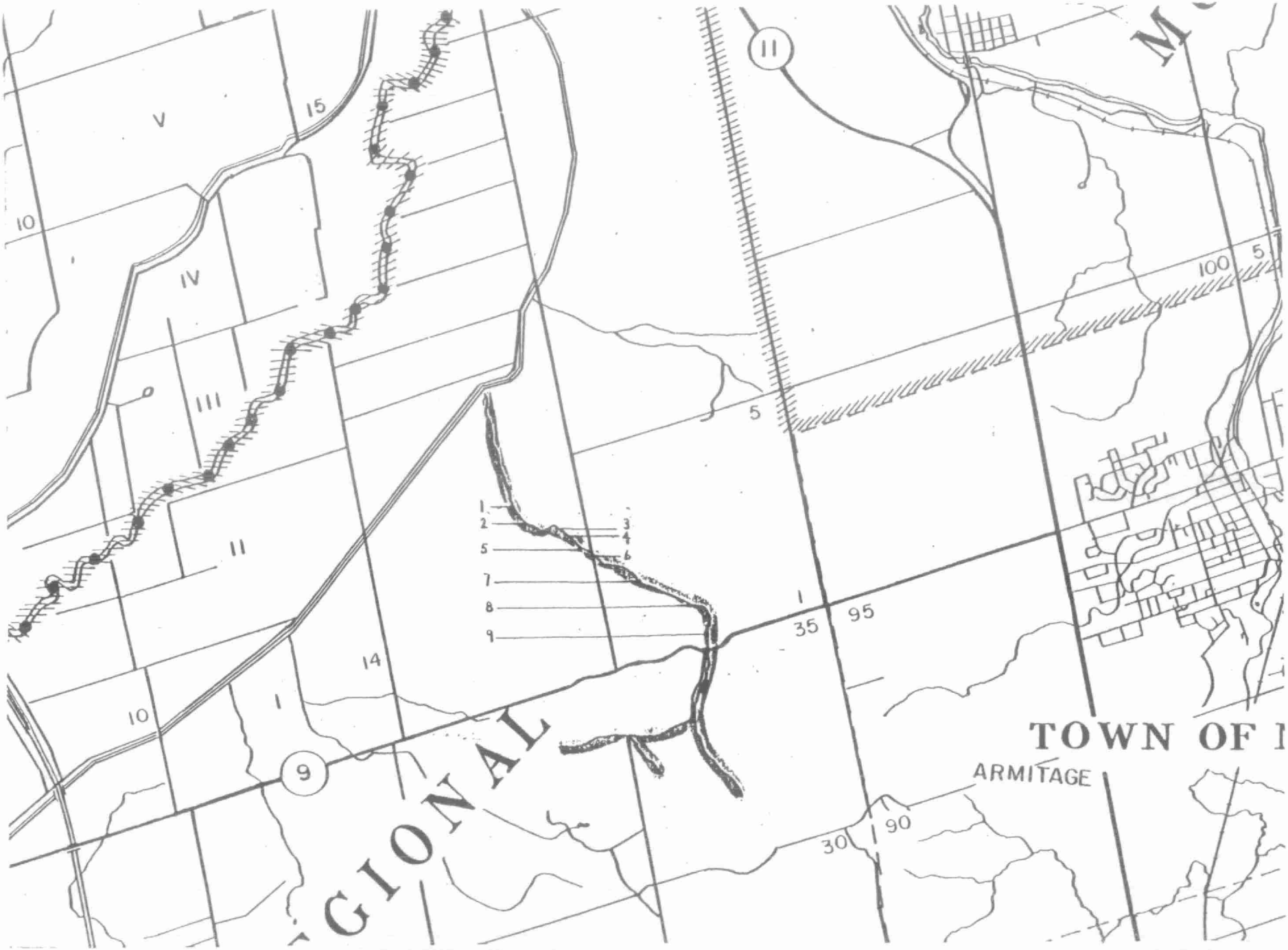

FIGURE 32. LOCATION OF SITES GLENVILLE CREEK

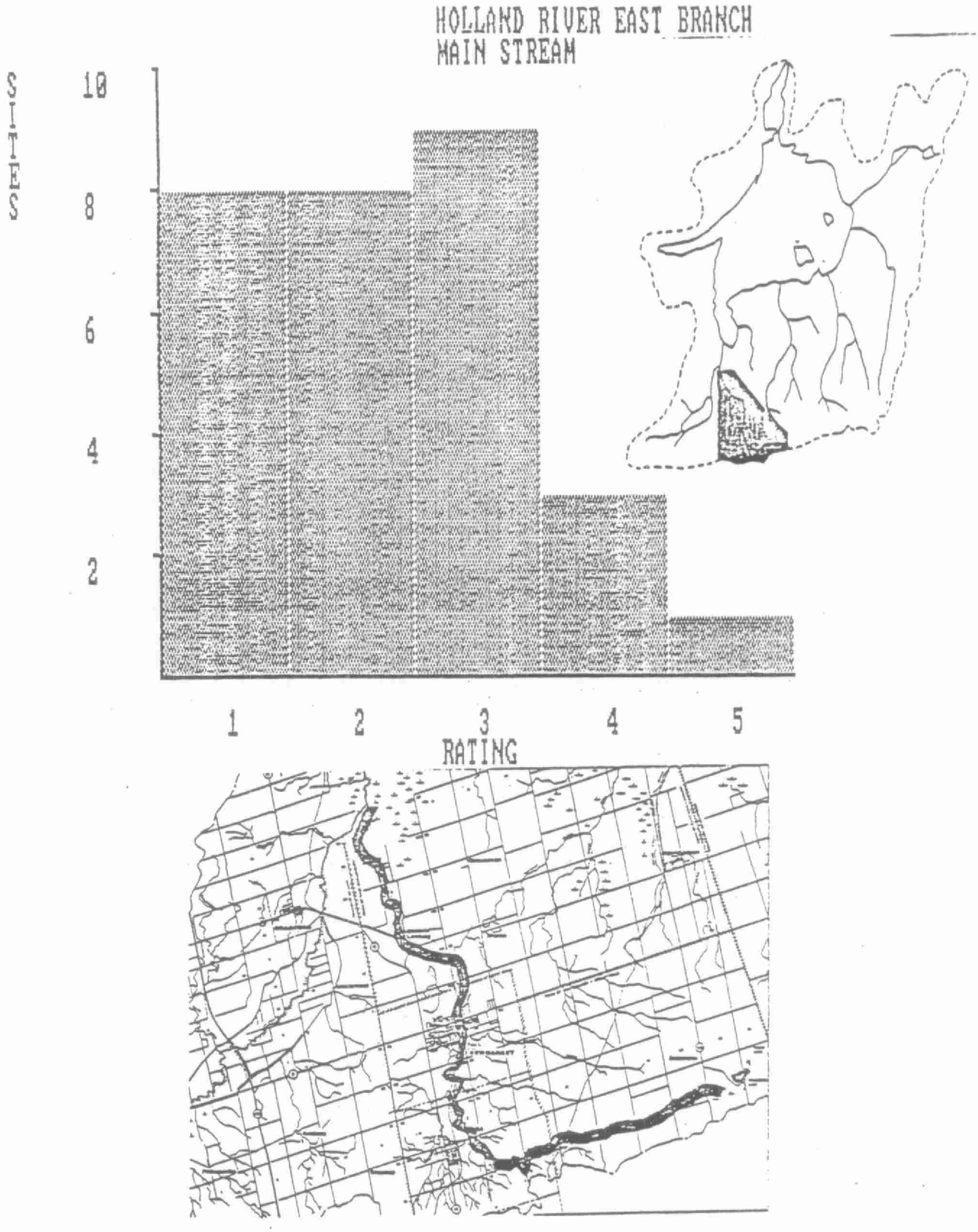

FIGURE 33. NUMBER OF SITES/RATING

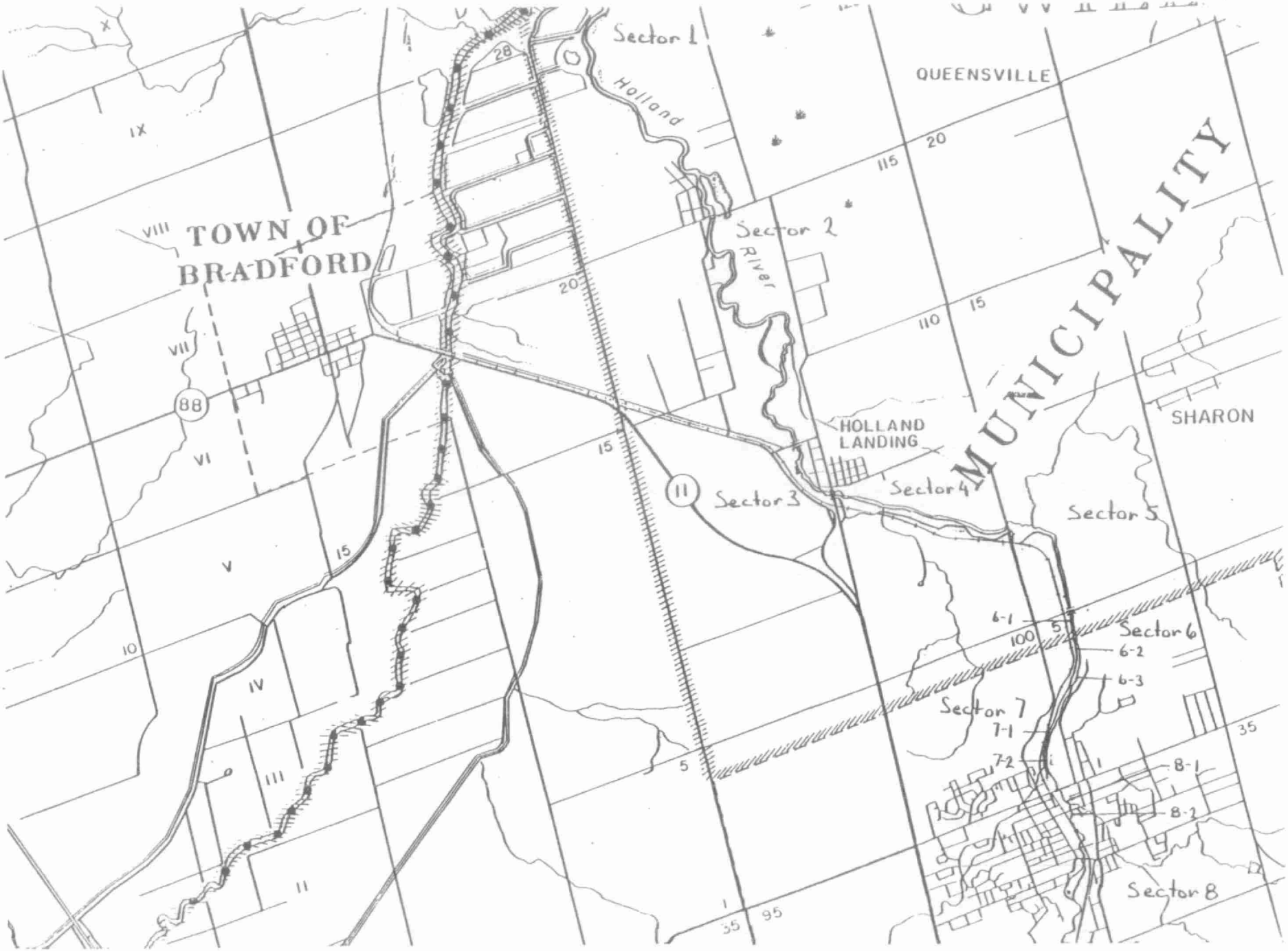

FIGURE 34 LOCATION OF SITES HOLLAND RIVER EAST BRANCH MAIN STREAM - NORTH SECTION

FIGURE 35 LOCATION OF SITES HOLLAND RIVER EAST BRANCH MAIN STREAM - SOUTH SECTION

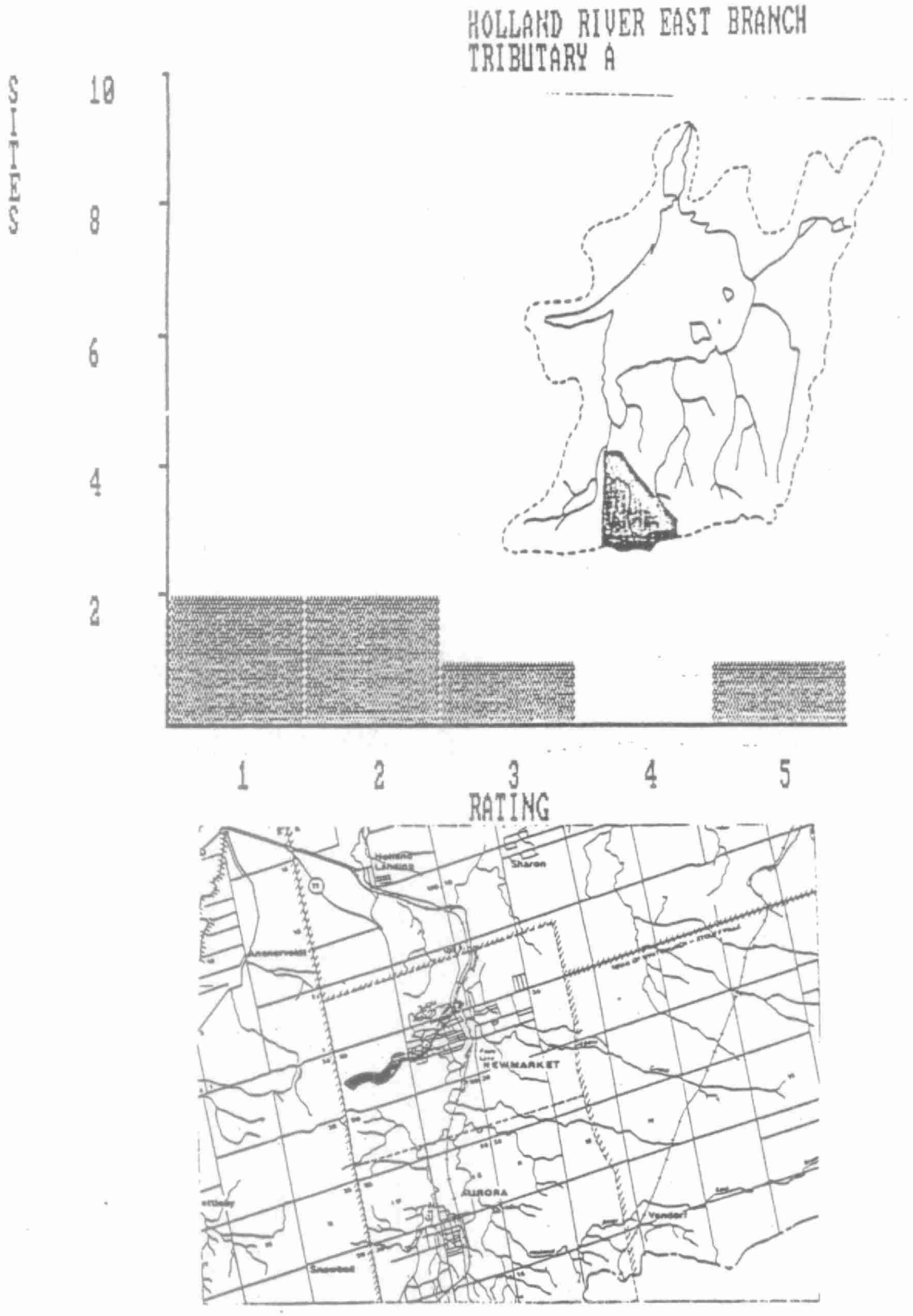

FIGURE 36. NUMBER OF SITES/RATING

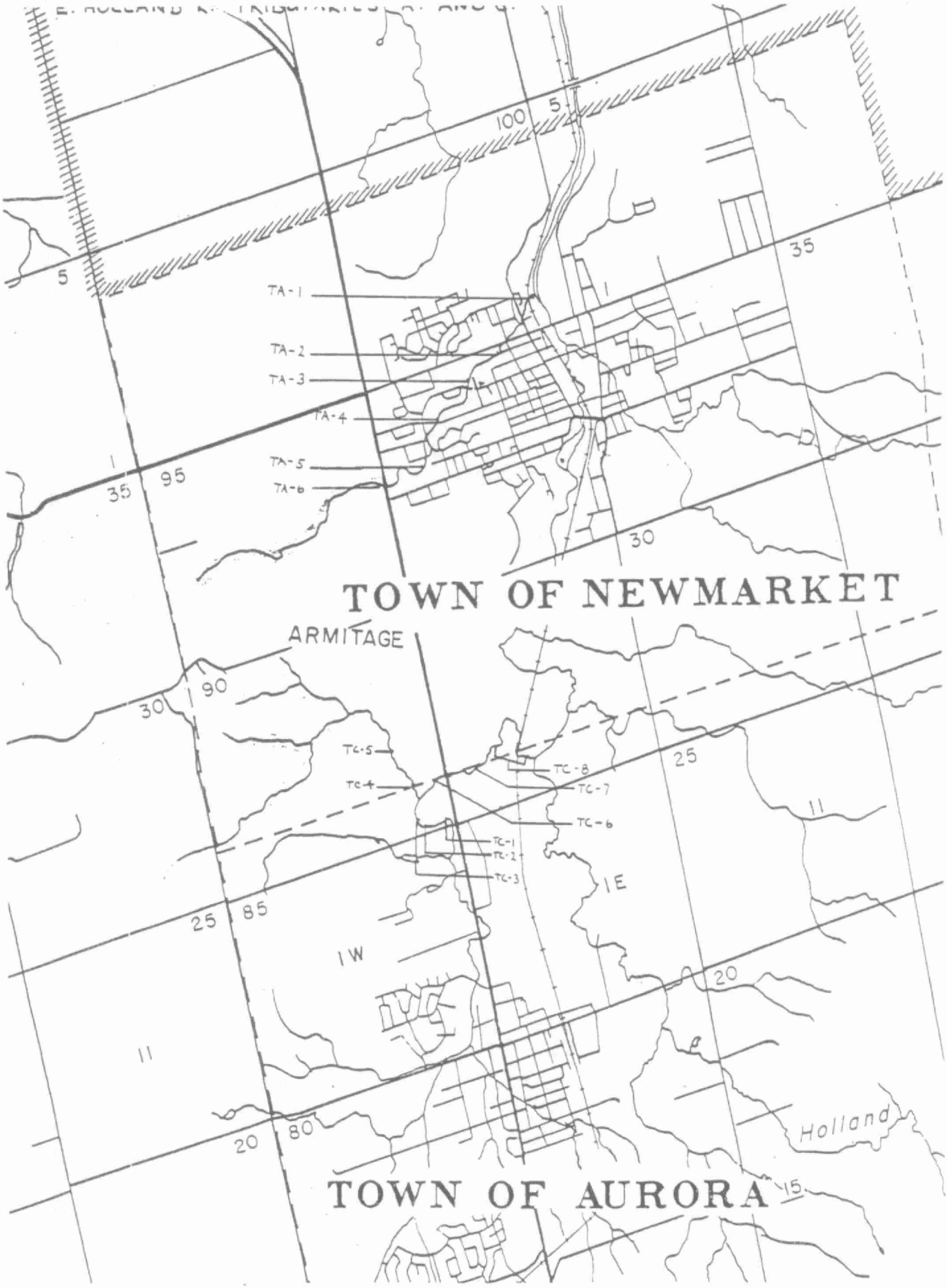

FIGURE 37 LOCATION OF SITES HOLLAND RIVER EAST BRANCH TRIBUTARIES A AND C

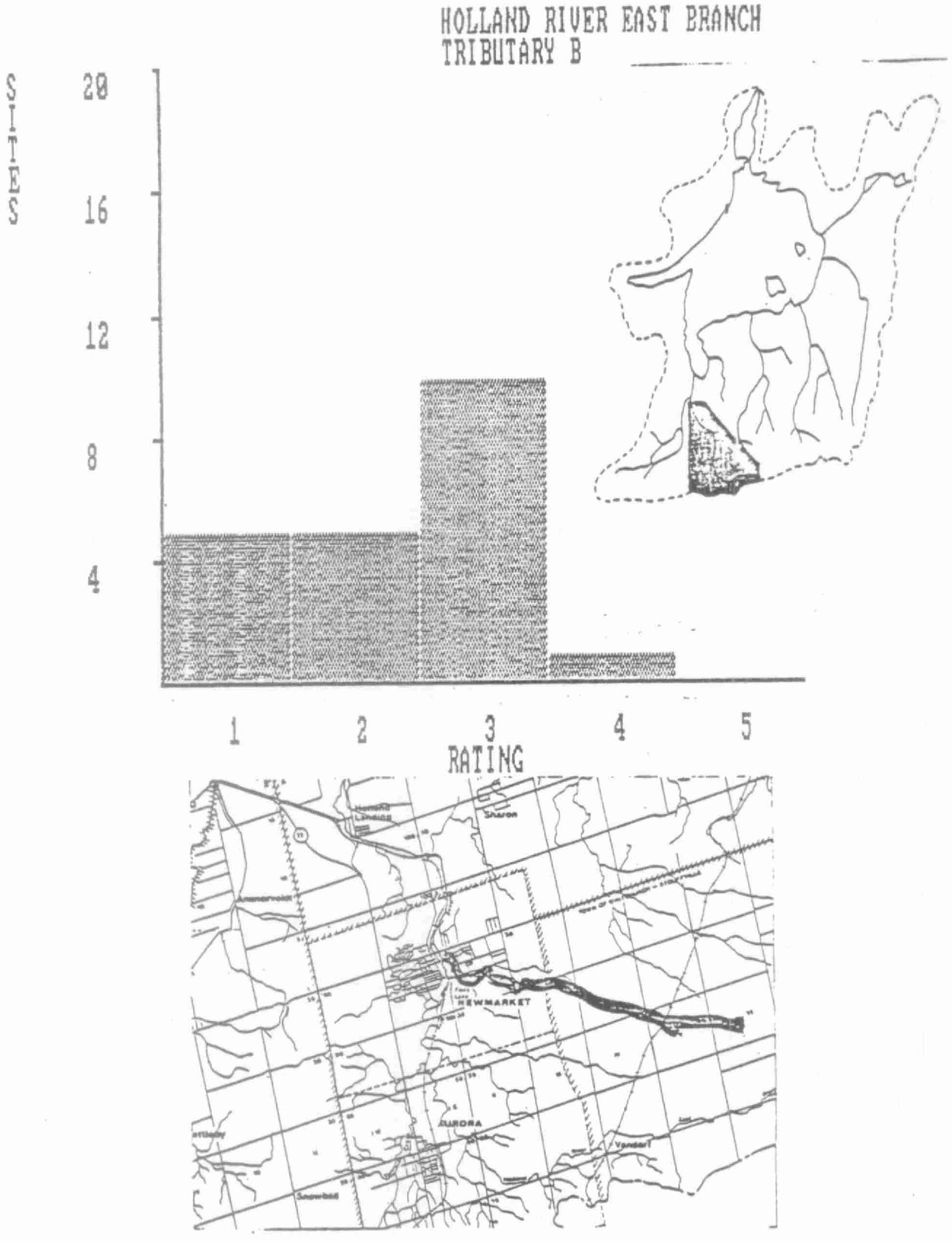

FIGURE 38 NUMBER OF SITES/RATING

FIGURE 39 LOCATION OF SITES HOLLAND RIVER EAST BRANCH TRIBUTARY B

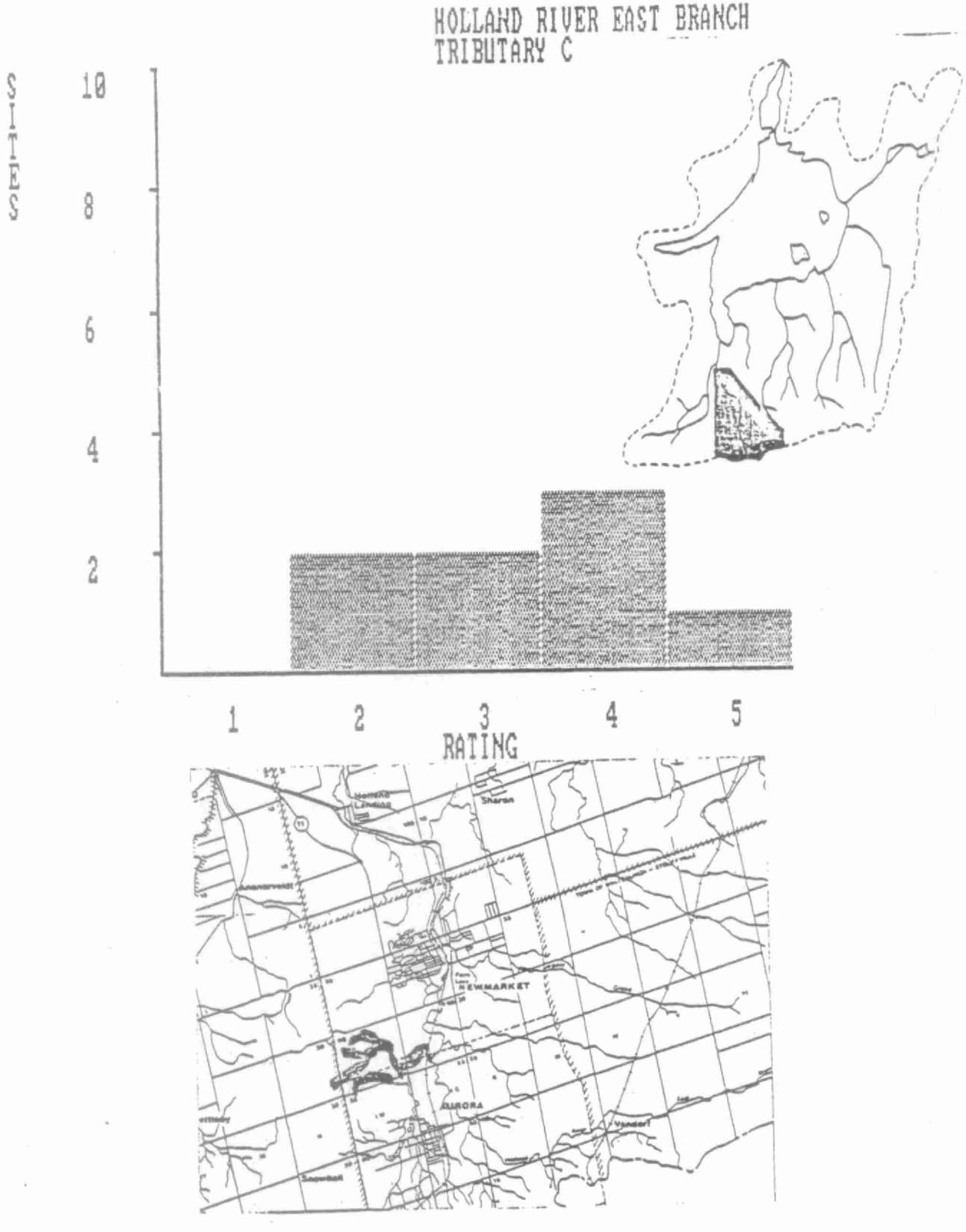

FIGURE 40. NUMBER OF SITES/RATING

Table 1
Number of sites per rating / type
Holland River
Main Stream

Rating:	1	2	3	4	5	
Natural Bank Erosion	7	5	2	2	2	18
Gullying	8	5	1	1	0	15
Trampling	2	1	1	1	0	5
Inappropriate Practices	0	0	1	1	0	2
	17	11	5	5	2	Total: 40

Table 2
Number of sites per rating / type
Holland River
Tributary A

Rating:	1	2	3	4	5	
Natural Bank Erosion	2	2	0	0	0	4
Gullying	0	0	0	0	0	0
Trampling	1	0	0	0	0	1
Inappropriate Practices	2	0	0	0	0	2
	5	2	0	0	0	Total: 7

Table 3
Number of sites per rating / type
Holland River
Tributary B

Rating:	1	2	3	4	5	
Natural Bank Erosion	4	2	1	1	2	10
Gullying	1	1	1	0	0	3
Trampling	1	0	0	0	0	1
Inappropriate Practices	4	0	0	0	0	4
						Total:
	10	3	2	1	2	18

Table 4
Number of sites per rating / type
Holland River
Tributary C

Rating:	1	2	3	4	5	
Natural Bank Erosion	1	3	1	0	0	5
Gullying	0	3	0	0	0	3
Trampling	2	0	0	0	0	2
Inappropriate Practices	0	1	0	0	0	1
						Total:
	3	7	1	0	0	11

Table 5
Number of sites per rating / type
Holland River
Tributary D

Rating:	1	2	3	4	5	
Natural Bank Erosion	1	0	0	0	0	1
Gullying	2	0	0	1	0	3
Trampling	2	1	1	0	0	4
Inappropriate Practices	1	1	1	0	0	3
	6	2	2	1	0	Total: 11

Table 6
Number of sites per rating / type
Holland River
Tributary E

Rating:	1	2	3	4	5	
Natural Bank Erosion	0	0	0	0	0	0
Gullying	1	0	0	0	0	1
Trampling	0	0	0	0	0	0
Inappropriate Practices	0	0	0	1	0	1
	1	0	0	1	0	Total: 2

Table 7
Number of sites per rating / type
Holland River
Tributary F

Rating:	1	2	3	4	5	
Natural Bank Erosion	2	1	1	0	0	4
Gullying	1	1	1	0	0	3
Trampling	0	0	1	0	0	1
Inappropriate Practices	2	0	0	1	0	3
	5	2	3	1	0	Total: 11

Table 8
Number of sites per rating / type
Holland River
Tributary G

Rating:	1	2	3	4	5	
Natural Bank Erosion	4	1	1	0	0	6
Gullying	2	5	0	0	0	7
Trampling	3	0	0	0	0	3
Inappropriate Practices	1	1	1	0	0	3
	10	7	2	0	0	Total: 19

Table 9
Number of sites per rating / type
Holland River
Tributary H

Rating:	1	2	3	4	5	
Natural Bank Erosion	8	8	1	1	0	18
Gullying	2	1	0	0	0	3
Trampling	0	0	0	0	0	0
Inappropriate Practices	1	1	0	0	0	2
	11	10	1	1	0	Total: 23

Table 10
Number of sites per rating / type
Holland River
Tributary K

Rating:	1	2	3	4	5	
Natural Bank Erosion	0	1	1	0	0	2
Gullying	0	0	0	0	0	0
Trampling	0	0	0	0	0	0
Inappropriate Practices	2	0	0	0	0	2
	2	1	1	0	0	Total: 4

Table 11
Number of sites per rating / type
Holland River
Tributary L

Rating:	1	2	3	4	5	
Natural Bank Erosion	2	0	2	1	1	6
Gullying	1	0	0	0	0	1
Trampling	1	2	0	0	0	3
Inappropriate Practices	0	1	0	0	0	1
					Total:	
	4	3	2	1	1	11

Table 12
Number of sites per rating / type
Pottageville Creek

Rating:	1	2	3	4	5	
Natural Bank Erosion	2	1	1	0	0	4
Gullying	0	0	0	0	0	0
Trampling	0	0	0	0	0	0
Inappropriate Practices	0	0	0	0	0	0
					Total:	
	2	1	1	0	0	4

Table 13
Number of sites per rating / type
Kettleby Creek
Main Stream

Rating:	1	2	3	4	5	
Natural Bank Erosion	7	7	5	7	5	31
Gullying	0	2	1	0	2	5
Trampling	0	2	1	0	0	3
Inappropriate Practices	3	0	0	0	1	4
	10	11	7	7	8	Total: 43

Table 14
Number of sites per rating / type
Kettleby Creek
Tributary C

Rating:	1	2	3	4	5	
Natural Bank Erosion	3	0	3	0	0	6
Gullying	0	1	0	0	1	2
Trampling	1	1	0	0	0	2
Inappropriate Practices	1	1	0	0	0	2
	5	3	3	0	1	Total: 12

Table 15
Number of sites per rating / type
Glenville Creek

Rating:	1	2	3	4	5	
Natural Bank Erosion	4	0	0	0	0	4
Gullying	1	1	0	0	0	2
Trampling	0	0	1	0	0	1
Inappropriate Practices	1	0	0	0	1	2
	6	1	1	0	1	Total: 9

Table 16
Number of sites per rating / type
Holland River East Branch
Main Stream

Rating:	1	2	3	4	5	
Natural Bank Erosion	2	1	3	3	1	10
Gullying	2	4	3	0	0	9
Trampling	2	2	1	0	0	5
Inappropriate Practices	2	1	2	0	0	5
	8	8	9	3	1	Total: 29

Table 17
Number of sites per rating / type
Holland River East Branch
Tributary A

Rating:	1	2	3	4	5	
Natural Bank Erosion	0	1	1	0	0	2
Gullying	0	0	0	0	1	1
Trampling	0	0	0	0	0	0
Inappropriate Practices	2	1	0	0	0	3
					Total:	
	2	2	1	0	1	6

Table 18
Number of sites per rating / type
Holland River East Branch
Tributary B

Rating:	1	2	3	4	5	
Natural Bank Erosion	2	3	8	0	0	13
Gullying	1	1	1	1	0	4
Trampling	1	1	1	0	0	3
Inappropriate Practices	1	0	0	0	0	1
					Total:	
	5	5	10	1	0	21

Table 19
Number of sites per rating / type
Holland River East Branch
Tributary C

Rating:	1	2	3	4	5	
Natural Bank Erosion	0	1	0	2	1	4
Gullying	0	0	0	1	0	1
Trampling	0	0	2	0	0	2
Inappropriate Practices	0	1	0	0	0	1
	0	2	2	3	1	Total: 8

Table 20
Number of sites per rating / type
for all of the study area.

Rating:	1	2	3	4	5	
Natural Bank Erosion	51	37	31	17	12	148
Gullying	22	25	8	4	4	63
Trampling	16	10	9	1	0	36
Inappropriate Practices	23	9	5	3	2	42
	112	81	53	25	18	Total: 289

APPENDIX A

DATA SHEET

EROSION INVENTORY FIELD DATA SHEET

Site Number _____ Aerial Photo Number _____

Watercourse _____ River _____

Tributary _____

Municipal Drain _____

Date _____ Time _____

1. STREAM

   Width _____ Maximum Depth _____

2. BANK

   Height _____ Angle _____

   % Coverage _____ Vegetation: Grasses _____

   Shrubs, Bushes _____

   Trees _____

   Reeds, Sedges _____

   Shape: Concave _____

   Convex _____

   Unform _____

   Complex _____

3. ADJACENT AREA

   Specific Crops: Row Crop _____ Other: Barren _____ Fallow _____

   Pasture _____ Scrub _____ Swamp _____

   Grains _____ Wooded _____ Residential ___

   Tillage: N.A. _____ Up and down slope _____

   Zero _____ Contour _____

   Disc/Chisel _____

   Furrow Plowing _____

   Buffer Strip Width _____ Vegetation: Grasses _____

   Shrubs, Bushes _____

   Trees _____

   Reeds, Sedges _____

   Cattle Access _____

   Tile Outlets/Other Outlets _____

4. EROSION

Extent: Minor 1 2 3 4 5 Severe

Length on Shoreline _____

Height on Bank _____

Type(s): Trampling _____

Undercutting _____

Slumping _____

Gullying _____

Length _____

Depth _____

5. FEEDLOT OR MANURE

Distance from stream _____

6. DUMPING OR REGRADING _____

7. OBSTRUCTION: Trees/logs____Dam_____Weir____Rocks____Culvert____

Type: CSPA _____

CSP _____

Box _____

Bridge _____

Height _____

Width _____

Length _____

8. PHOTO # _____

9. ADDITIONAL COMMENTS:

APPENDIX B

SITE IDENTIFICATION SYSTEM, PROPOSED REMEDIAL MEASURES, AND SITE DESCRIPTIONS

Site Identification System

The first letter-number combination refers to the orthophotographic record of the site locations (under separate cover). The letter prefix denotes orthophotographs of:

T - Tecumseth Township,

K - King Township, Aurora, Whitchurch-Stouffville,

N - Newmarket.

Where orthophotoghraphic coverage of the area is unavailable, the National Topographic System map used is referred to as TOPO.

The second letter-number sequence is the date that the site was visited and catalogued. The letters refer to:

M - May,

J - June,

U - July,

A - August.

The next portion of the code is either a site number, a sector number (for a main stream) or a group of letters (for the tributaries of the stream). If length warrants, the main stream is divided into sectors that are numbered from the mouth to the headwaters. Tributaries are also lettered as they are encountered from the mouth to the headwaters.

If the location requires a sector number or a tributary identifier, the next number is the site number.

The last letter(s) refer to the bank(s) of the watercourse on which the site is located. For the purpose of assigning east or west, it is assumed that all streams flow north.

Example: T65-M17-1-1-EW

The site is mapped on Tecumseth Township orthophoto #65.

The site was catalogued on May 17,1983.

The site is found in sector #1.

The site is the first site in the sector.

The erosion problem affects both banks of the stream.

Proposed Remedial Measures

The purpose of the recommendations that follow each site description is reduced streambank erosion. It is stressed that selecting the most appropriate control measure for an erosion site requires a detailed individual site investigation. It is necessary to determine all of the causes of the problem and the possible consequences of any implementation. Application of an inappropriate remedial measure may fail to correct the problem and may even aggravate it.

A possible consequence of major concern is the loss of fish habitat. Instream obstructions and undercut banks can be causes of streambank erosion as well as valuable fish habitat. Provisions should be made for the creation of alternate habitat in all plans which call for the removal of instream obstructions or the regrading of streambanks. The possibilities for creating or improving habitat should be a priority whenever streambank erosion control measures are contemplated.

HOLLAND RIVER
MAIN STREAM

T65-M17-1-1-EW (rating N/A)

An obstruction caused by logs extends across the entire 10m width of the watercourse. The location of the obstruction is approximately 61m upstream of the bridge on Highway #9.

Recommendation: Clear the debris from the river.

T65-M17-1-2-E (rating N/A)

An obstruction very similar to that at site # 1. This site is located 150m east of Concession 24.

Recommendation: Clear the debris from the river.

T65-M17-1-3-EW (rating N/A)

An obstruction caused by fallen trees located 30m east of Concession 24.

Recommendation: Same as above.

T65-M17-2-1-E (rating 4)

An obstruction of fallen trees has caused the watercourse to divert from its normal channel. Extreme undercutting and slumping of the bank has produced a new stream bed cut 9m into the east bank, 19.5m along the previous shoreline.

Recommendation: Clean obstruction from the stream. Fill and regrade the eroded area and revegetate the bank.

T65-M17-2-2-E (rating 2)

A gully on the east bank may have been caused by horse trampling or by machinery access to the stream. Dimensions of the gully: length along shoreline is 11m, extent into the bank is 11m and the depth from the top of the bank to

water line is 1m.

Recommendation: A proper crossing should be constructed for the livestock or machinery and, if necessary, fence off the stream.

T65-M17-2-3-EW (rating 4)

Trampling of banks on both sides of the watercourse by horses at a site located 30m upstream from the confluence of the stream with Tributary A.

Recommendation: Fence off the watercourse, grade banks and gravel bed to construct an animal crossing.

T65-M18-2-4-EW (rating 1)

An obstruction caused by a fallen bridge. The built up section of the bank on the east side that previously supported the bridge is now slumping into the stream. The stream width is 5.8m and its depth is 0.6m.

Recommendation: While the erosion is minor, the obstruction should be removed.

T65-M18-2-5-E (rating 3)

Undercutting and slumping on the east bank has created a problem. With trees fallen from the bank and the likely addition of more trees (roots exposed), an obstruction of logs is building. The erosion extends about 15m along the shoreline and the entire 1.2m high bank is bare.

Recommendation: The steep (60 - 70 degree) bank should be cleared, regraded and seeded, or gabion baskets could be used to strengthen the bank.

T65-M18-2-6-W (rating 1)

A gully that started in a rodent dwelling has cut the shoreline back 4.9m from the waters edge. This gully is 1.5m deep and extends 2.4m along the shoreline. Runoff from

adjacent farm fields through the gully, and seepage near the bottom of the gully are factors affecting erosion here.

Recommendation: Fill the gully and regrade banks. Revegetate the area to slow the erosion caused by seepage or install a seepage drain.

T-64-M18-2-7-EW (rating 4)

Severe undercutting of both of the 1.8m high banks extends for 30m along the shoreline. This has been caused by water flowing around a log obstruction that blocks most of the stream.

Recommendation: Clear the stream, revegetate the banks.

T64-M18-2-8-E (rating 4)

At the bridge on Highway #27 runoff from the south end of the bridge has eroded a gully that extends 60m from the road to the stream. The depth of the gully is 1.5m at the stream. The mouth extends for 3.5m along the east bank. Deposition at the mouth of the gully is filling the stream with sediment.

Recommendation: Construct a proper channel for runoff.

T64-M18-2-9-E (rating 1)

Gully cuased by runoff from a swail that drains a pasture. Sediments carried by this are being deposited in the stream. The gully measured 3.7m along the shoreline and was 1.2m deep at this point. Upstream from this there was a log jam.

Recommendation: Fill the gully and construct a drop structure or rock shute at the outlet of the swail. Clear out the log jam.

T64-M18-2-10-EW (rating 1)

Along the 500m stretch of the stream between Highway 27 and the 20th Sideroad there are several locations of slumping.

Recommendation: Regrade where necessary and vegetate the banks.

T64-M18-3-1-EW (rating 3)

West of the bridge over the 20th Sideroad and extending for 120m there is an area of cattle access to the stream. The cattle are allowed to cross the stream and there has been a significant amount of trampling. Also, at the end of this area there are steel rails and rocks across the stream obstructing flow.

Recommendation: Fence off the stream and construct a cattle crossing and a watering station. Remove the obstruction.

T64-M18-3-2-E (rating 1)

Slumping due to natural causes. There are also two similar sites upstream 15m and 45m. Three meters upstream from the first site of slumping a fallen tree is causing an obstruction.

Recommendation: Regrade and revegetate the slopes and remove the obstruction.

T64-M18-3-3-W (rating 1)

The bank is being undercut at a point just downstream from where Tributary B enters the stream. The length of the undercutting along the bank is 1m and the cut reaches 3m to the top of the bank. The fence posts running along the bank are about to fall over the edge.

Recommendation: Stabilize the bank, possibly by installing gabion baskets.

K109-M26-4-1-EW (rating 2)

For approximately 8m along the eastern bank there is natural undercutting and, to a lesser degree, slumping. The banks here are about 1.8m high and the erosion affects the entire

height of the bank. Also, at this site is an obstruction caused by fallen trees.

Recommendation: Clear out the obstruction, regrade and revegetate the banks.

K109-M26-4-2-W (rating 1)

Gullying is the problem at this site. Found within a pasture, the gully extends for 14m from the stream to a fence line and continues beyond that. It is 1.5m wide and cuts to the bottom of the 1.8m bank. This gully is well covered with grass and is only a minor problem.

Recommendation: Monitor this site to determine if the present cover is sufficient to control erosion.

K109-M26-4-3-E (rating 3)

There is both slumping and undercutting at this site. The stream has been redirected by a log jam. Due to the erosion, the streams' width has been expanded to 6.1m. The banks on which this erosion occurs are 4.6m high.

Recommendation: Clear out the log obstruction, regrade and vegetate the banks.

K109-M26-4-4-EW (rating 2)

Upstream from the culvert, on the west bank of the stream there is a gully 0.9m wide and 1.5m deep. It has been caused by runoff from a ditch that runs along the parking lot of the arena. Upstream from this gully, stretching through the residential area for approximately 250m there are numerous drains mainly on the east bank coming out of backyards.

Recommendation: For the gully, construct a proper drainage channel and an appropriate outfall at the mouth of the gully. Monitor the outlets of the drains to ensure that they do not create erosion problems.

K109-M26-4-5-W (rating 2)

Upstream from the fairgrounds, past the point where the stream curves eastward towards the main street, there is a gully on the west bank. It is 1.8m wide and 1.2m deep and more than 60m long.

Recommendation: Construct a proper drainage channel and outlet structure.

K110-M26-4-6-W (rating 1)

Upstream from the lumber yard is a gully; probably caused by runoff from a street gutter. The length of the gully is approximately 60m. It is 0.6m wide and 1.8m deep.

Recommendation: Construct a proper drainage channel and outlet structure.

K110-M26-4-7-E (rating 2)

At a site 30.5m downstream from the convergence of Tributary D with the main stream, a natural slumping problem exists. Drainage from the high surrounding ground has caused the east bank to slump into the stream.

Recommendation: Stabilize the east bank with rip rap, gabion baskets, or by regrading and seeding.

K134-M26-4-8-E (rating 5)

At a site 90m upstream from the bridge at Main Street, there is a very high bank. The face of the bank is inclined at an angle of 80 degrees. For a height of 15m, the bank is bare clay and loose soil is slumping down the bank.

Recommendation: This is a severe erosion problem. The bank should be stabilized with gabion baskets.

K134-M26-4-9-EW (rating 2)

There is minor undercutting along a meandering section of

stream that extends for 365m through a forested area. Multiple tree falls in this section of the watercourse are causing obstructions and changing the course of the stream.

Recommendation: Clear the obstructions and restabilize the worse areas of undercutting.

K133-M26-4-10-W (rating 3)

At this site there is a gully that is 15m long, 1.2m deep and 1.2m wide. The soil around the river is loose and water sodden. This may become a major erosion problem. The gully begins near a line of houses directly to the north.

Recommendation: A proper drain should be constructed to control runoff from the street and from the yards and roof leaders of the homes.

For the rest of sector 4, there were only foot bridges, large culverts (> 2.4m diameters), drains (properly constructed with rodent traps), and minor obstructions due to fences and tree falls. This stream is in good condition.

K156-M26-5-1-W (rating 2)

As the stream meanders sites of undercutting and slumping occur along the 1.8m high west bank. At these sites the angle of the bank is 90 degrees. The stream is surrounded by pasture and cattle access is likely. The severity of this erosion problem may increase.

Recommendation: Regrade and vegetate the bank. Monitor this site to determine if it is necessary to restrict access of cattle to the stream.

K155-M26-5-2-EW (rating 1)

Along a 250m stretch of stream across a horse farm the stream meanders through the pastures. Therefore, a potential problem of trampling exists.

Recommendation: Continued surveillance of this area to

determine if restriction of horse access to the stream is necessary.

K155-M26-5-3-E (rating 1)

This site is located directly beneath high power lines where runoff from the adjacent land is causing slumping. The banks on the east side of the stream are 3m high, they are at an angle of 80 degrees, and coverage is about 70 percent scrub. The stream here is bordered on the west bank by swampy flat land.

Recommendation: Establish a buffer strip at the top of the bank, or construct a surface diversion to reroute the runoff.

K155-M26-5-4-EW (rating 2)

Upstream 120m from the convergence of Tributary F, there is an area of extensive cattle trampling compounded by minor slumping. The cattle cross the stream at the confluence of the main stream and a small spring.

Recommendation: Restrict cattle access, construct a proper crossing.

K155-M26-5-5-W (rating 2)

A gully has been eroded at this site. Water from the outlet of a pond overflow pipe has eroded the bank to form a gully 3m deep, 1.2m long and 1.8m wide.

Recommendation: This gully should be filled and the overflow from the pond should be properly drained into the stream.

K155-M26-5-6-W (rating 4)

The land around the stream in this area had been recently worked by heavy machinery and the west bank has been regraded. Logs pushed into the stream are altering the streams' course causing undercutting and slumping. The west

bank is 2m high and the angle of the bank is now 90 degrees. The length of this site along the shoreline is 30m. There is also a bridge nearby that is trapping logs and creating an obstruction.

Recommendation: Clear the stream. Revegetate the banks and redesign the bridge so that it no longer traps floating debris.

154-M27-7-1-EW (rating 1)

Runoff down the slopes on the east side of the stream is cutting a gully into the bank. The length of the opening at the shoreline is 15m. The 2.4m high banks were relatively bare except for some trees. There is also a treefall at this site.

Recommendation: Revegetate east bank to reduce the velocity of the runoff and clear the debris from the stream ground cover.

K154-M27-7-2-W (rating 1)

A gully on the west side of the stream has made a cut 3m into the bank, 1.2m deep and 1m wide. Runoff from an adjacent farm pasture appears to be the cause of the problem. There is also a log obstruction about 10m upstream.

Recommendation: Increase the width of the buffer zone and clear the obstruction.

K154-M27-7-3-EW (rating 2)

At this site both banks have been undercut for 15m along the shoreline. The cause of the problem is a log obstruction which altered the watercourse. The stream here is about 2.4m wide and 0.3m deep. The banks are 1.5m high and the angle of the banks is about 80 degrees. Upstream about 3m on the west bank a small gully is forming in the soggy soil around a 5cm diameter black hose.

Recommendation: Stabilize the undercut area and remove the log obstruction. Fill the gully and stabilize the area with rip rap.

K154-M27-7-4-EW (rating 1)

This is a site of trampling due to cattle access. The entire length of the stream is affected as it flows from the pasture fence to the culvert at a driveway, 300m west of Concession 11.

Recommendation: Limit cattle access by fencing off the stream.

K154-M27-7-5-E (rating 1)

On the north side of the 19th Concession where the stream passes through a culvert a is gully forming on the east bank. Runoff from the road flows through the gully down the 2m bank. The gully is 6m long and 1.5m deep at the culvert.

Recommendation: Place rip rap or gabion baskets around the culvert to reduce erosion.

K174-M30-8-1-W (rating 3)

On the west side of an in-stream pond the bank has been filled and regraded with topsoil. The loose soil is now slumping into the pond. This site extends along the shore for about 8m and to the top of the 1.2m banks.

Recommendation: Revegetate the bank to stabilize the soil.

K174-M30-8-2-W (rating 1)

A spring has created a gully that is 3m wide at the shoreline, 0.3m deep and 5m long. There is a large amount of sediment in the stream at the mouth of the gully.

Recommendation: Install seepage drains, fill the gully, and vegetate the banks.

K173-M30-8-3-E (rating 1)

A rock pile on east side of stream is causing the water to divert and undercut the bank.

Recommendation: Remove obstruction.

K173-M30-8-4-W (rating 1)

The 10m high banks are at an angle of 80 degrees. Sparse vegetation permits natural slumping and gravitational erosion to occur along the shoreline for 15m.

Recommendation: Regrade and vegetate the slopes.

K173-M30-8-5-EW (rating 5)

Upstream 30m from the previous site a beaver dam extends for about 90m across the floodplain. The dam is 2.2m high and has flooded a farm field and part of a bush. Leaks in the dam are creating many new streamcourses. Upstream of the dam the originally 1.2m - 1.5m wide stream is 10m wide. There are several fences across the ponded area that are catching logs and causing obstructions.

Recommendation: Relocation of beavers by trapping. Remove the beaver dam and clean up the pond area to allow the stream to resume its original course.

K191-M30-9-1-W (rating 2)

At this site there is a gully formed by a ditch that enters the stream from the west. The ditch is constructed to handle the overflow from a pond. There is a lot of sediment from the sides of the ditch in the stream.

Recommendation: Regrade and vegetate the sides of the ditch.

HOLLAND RIVER
TRIBUTARY A

T64-M17-TA-1-W (rating: 2)

Approximately 30m upstream from the 2nd line there is a site of natural slumping. The stream occupies approximately 1.5m of the 7m wide channel. During times of high flow it occupies all 7m. The east bank of the stream has been undercut by high flow waters.

Recommendation: Regrade and seed the banks.

T64-M17-TA-2-E (rating: 1)

A tile outlet from a pond on the east side drains directly into the stream. Sediments have been deposited where the drain outlet enters the stream. The stream channel has also been recently dredged.

Recommendation: Seed the bare west bank.

T63-M17-TA-3-W (rating: 2)

A section of slumping banks extending for 120m upstream. The banks were bare to a height of 0.6m up from the surface of the stream. Adjacent farm fields were tilled to the edge of the stream.

Recommendation: Seed the bare banks and create a wider buffer strip.

T63-M17-TA-4-EW (rating: 1)

At this site there is a manure pile on the stream's east bank. Also, a fence across the stream has created a back-up of grasses and garbage.

Recommendation: The manure should be moved to a proper storage facility and the obstruction should be removed.

T63-M16-TA-5-EW (rating: 1)

An area of cattle access along a 250 m stretch of the stream.

Recommendation: Fence off the stream and construct crossings and watering stations.

T63-M16-TA-6-W (rating: 1)

At this site the stream is 4.3m wide and 0.3m deep, the angle of the bank is approximately 80 degrees. The problem is undercutting of the 1.5m high bank. The land is worked to the waters' edge in places and the banks are slumping into the stream.

Recommendation: Increase the extent of buffer strip, regrade and seed badly eroded banks.

T63-M17-TA-7-W (rating: 1)

Very minor undercutting of 0.3m high banks (natural erosion).

Recommendation: Regrade and seed the banks.

HOLLAND RIVER
TRIBUTARY B

T64-M18-TB-1-E (rating: 5)

Excessive slumping of a 12m high bank on the east side of the stream. The length of the erosion problem along the shoreline is 30m. The cause of the erosion is probably natural conditions as well as runoff from the road.

Recommendation: Regrade and vegetate the slope.

T63-M18-TB-2-EW (rating: 1)

On the section of the stream that extends for 300m upstream from site T64-M18-TB-1-E there are numerous minor spots of natural undercutting. About 120m from the beginning of this section there is a fence obstructing the path of the stream.

Recommendation: Remove the obstruction, regrade and seed or riprap where necessary.

T63-M18-TB-3-W (rating: 1)

Within the orchard there is a gully adjoining the west bank of the stream. The gully is 20m in length and 1.1m deep.

Recommendation: Fill in the gully and seed the area.

T63-M18-TB-4-E (rating: 5)

Approximately 30m before the end of the section refered to in site T63-M18-TB-2-EW, there is a spot of extreme undercutting on the east bank. The affected area extends for 15m along the shoreline and includes all of the 10m height of the bank.

Recommendation: Stabilize streambed and banks with riprap after regrading the bank.

T63-M18-TB-5-EW (rating: 1)

For approximately 370m there is cattle access to the stream. The banks display the effects of minor cattle trampling. Also within this area is a fence obstructing the stream.

Recommendation: Restrict the cattle access and relocate the fence.

T63-M18-TB-6-E (rating: 4)

Natural undercutting is the erosion problem. The affected area extends for 23m along and all the way up the 1.5m high east bank. This area also has cattle access to it.

Recommendation: Stabilize the streambed and bank with riprap after regrading the bank.

T63-M18-TB-7-W (rating: 1)

At this site there is 6m stretch of natural undercutting along the west shore of the stream that reaches 1.3m up the bank. A tree on the bank is about to fall into the stream. Downstream for 180m and ending where a fence is obstructing the path of the stream there is an area of minor undercutting.

Recommendation: Remove the tree, regrade and vegetate the serious areas of undercutting.

T63-M18-TB-8-EW (rating: 2)

At this site the stream divides into two channels. On the east branch there is slumping and undercutting of the east bank. This extends for 10m along and for 3m up the bank. On the west branch there is a small waterfall. A vertical drop of 1m is causing the streambed to cut back along it's bed.

Recommendation: Revegetate the east bank to prevent slumping. Reroute both channels through a single rock shute or drop structure.

T63-M18-TB-9-EW (rating: 1)

From site TB-8 until the stream reaches the 17th sideroad (about 1km), there are isolated minor, moderate, and extensive sites of undercutting. There is also an obstruction caused by a fence in this area.

Recommendation: Revegetate the banks at all sites and, for more moderate and extensive erosion sites, regrading may be necessary.

T63-M24-TB-10-W (rating: 1)

Minor undercutting and slumping at a bend in the stream may be compounded by cattle access. The erosion extends up the west bank approximately 1.5m and along the shoreline for 12m.

Recommendation: Regrade and riprap the bank. Monitor this site to determine if it is necessary to restrict cattle access to the stream.

T63-M24-TB-11-EW (rating: 1)

On the east side of the stream a 30m stretch of the bank has been graded back from the stream. The grading has removed all vegetative cover. There is also some minor slumping on the west bank.

Recommendation: The east and west banks should be seeded and stabilized.

T62-M24-TB-12-E (rating: 2)

At this site a gully cuts approximately 50m into the east bank. The gully is about 10m wide and 5m deep. The gully is filled with rooted and fallen trees and scrub. Large amounts of sediment have been deposited on the flood plain about 7.5m from the stream's east bank.

Recommendation: Construction of check dams in the gully and a proper channel to handle runoff.

T62-M24-TB-13-EW (rating: 2)

At this site are several areas of undercutting that extend 20m - 25m along the shoreline and up to 3m up the bank. Spring water flowing from the banks is eroding the bank and carrying sediments to the main stream.

Recommendation: Construction of seepage drains to carry the spring water to the stream.

T62-M24-TB-14-E (rating: 3)

At this site a waterfall is cutting back along the streambed. The drop of the water is 1.3m.

Recommendation: A drop structure should be constructed to stop further erosion along the streambed.

T62-M24-TB-15-W (rating: 1)

A bend in the stream brings it adjacent to a worked farm field. Runoff from the farm field enters the stream at a point where there is a large amount of sediment deposited in the stream.

Recommendation: Increase the width of the buffer strip or construct a berm to reroute and decrease the velocity of the runoff.

T71-M24-TB-16-EW (rating: 1)

At this site a dam creates an in-stream pond. A concrete structure that was once part of the dam has been washed downstream. The stream is now flowing around the end of the dam.

Recommendation: Rebuild the dam to prevent further erosion of the fill used to create the dam.

T71-M24-TB-17-E (rating: 1)

Sediment is being deposited in the stream from the field on the east bank.

Recommendation: Establish a buffer zone.

T71-M24-TB-18-EW (rating: 3)

Two small streams from a swampy area converge to become Tributary B. The stream from the south has eroded a gully that extends from the confluence 11m to a 1m waterfall. The stream from the north has cut another gully 35m long.

Recommendation: Fill both gullies and construct a drop structure for the runoff from this swampy area.

HOLLAND RIVER
TRIBUTARY C

K109-J1-TC-1-EW (rating: 1)

There is a site of undercutting where the tributary turns to flow beneath the bridge at Hwy. #9. The width of the stream is 1.1m and the extent of the erosion along the streambank is approximately 15m.

Recommendation: Regrade and line the banks with riprap.

K109-J1-TC-2-E (rating: 2)

At this site there is a gully problem. Runoff from the field and park adjacent to the east bank enters the stream through the gully. The gully extends along the shoreline for 6m and is 20m long and 1m deep. The angle of the banks is approximately 70 degrees and the banks have a 70% cover of grasses.

Recommendation: Fill the gully and construct a berm to divert or a drop structure to accommodate the runoff.

K109-J1-TC-3-E (rating: 2)

There is a 30m stretch of streambank which has no vegetative cover. The soil on the east side is slumping into the stream. Within this area is a 1m diameter culvert where heavy equipment crosses the stream. The east bank has been regraded.

Recommendation: Regrade and vegetate the banks.

K109-J1-TC-4-W (rating: 1)

Concrete slabs have been placed in the stream to prevent erosion at this cattle watering station. This has not completely eliminated the trampling problem.

Recommendation: Restrict cattle access to the stream with fencing and allow the cattle to water at the small pond.

K109-J1-TC-5-E (rating: 2)

Along this 12m stretch of the 2m high east bank slumping has occurred. The farm fields are worked to the edge of the streambank. Even though these banks are planted with grasses, there is an erosion problem.

Recommendation: Regrade the banks to a more stable angle, seed them, and leave a wider buffer strip.

K109-J1-TC-6-E (rating: 2)

The east bank is being undercut along the entire length of this field. The banks are 2m high and they are inclined at an angle of 90 degrees.

Recommendation: Regrade and seed the banks, leave a wider buffer strip.

K109-J1-TC-7 (rating: 3)

East of concession #10 the stream breaks up and flows through many channels. The channels cut through wet, silty soil.

Recommendation: Construct a proper channel for the stream in order to eliminate the erosion of each individual channel.

K133-J1-TC-8-E (rating: 2)

Heavy farm equipment has trampled the streambank so that runoff from the surrounding fields now enters the stream at this site. A gully 1.1m deep and 2m wide is present.

Recommendation: Construct a proper crossing or access point for the machinery, and repair the damages to the banks.

K133-J1-TC-9-W (rating: 2)

At this site there is a gully entering the stream from a pasture. The gully is 4.6m long, 1.9m deep and 0.7m wide. There is another smaller gully entering the stream 12m upstream.

Recommendation: Regrade and seed the banks. Increase the width of buffer strip from its present 0.7m width.

K133-J1-TC-10-W (rating: 1)

Located east of the 10th line in King Township is an area of cattle trampling. The stream follows a fence line.

Recommendation: Construct another fence to block cattle access to the stream.

K133-J1-11-EW (rating: 2)

On both sides of the 2m culvert passing under Concession 10 in King Township are gullies caused by runoff from the road. They extend to the top of the 6m high banks and are 1m wide.

Recommendation: Fill the gully and construct a proper channel to accommodate runoff from the road surface.

HOLLAND RIVER
TRIBUTARY D

K110-M31-TD-1-E (rating: 1)

Behind the residential area to the east of Main Street in Schomberg is a 12m stretch of undercutting. The erosion extends up the bank for 1.8m.

Recommendation: Regrade and revegetate the east bank.

K110-M31-TD-2-E (rating: 1)

Downstream from the bridge crossing Main Street are two gullies within 6m of each other. The larger of the two is caused by a drain from a residential yard. This gully extends for 0.6m along the shore and cuts back 3.7m with a maximun depth of 1.4m. The other gully, further upstream, is not as severe.

Recommendation: Construct a proper drop structure at the end of the drain.

K134-M31-TD-3-E (rating: 1)

At this site is an exposed tile drain pipe. As the bank is 1.2m high, discharge from the pipe could cause an erosion problem.

Recommendation: Construct a proper drainage outlet.

K134-M31-TD-4-E (rating: 4)

In an area south of Main Street, homes are being constructed. Within this construction area is extensive gullying around a culvert under one of the newly built streets. The bank that this gully is on is 6m east of the stream. The bank is 4.5m high and the gully is 4.5m deep. This gully cuts back into the slope for 4.5m and parts of the road's pavement have broken off and fallen into the gully. Along this bank for 45m regrading has left the slope bare of any vegetation.

Recommendation: Fill in the gully. As the problem was

caused by runoff from the street, construct a surface diversion to channel the runoff down this slope. Revegetate the bank.

K134-M31-TD-5-EW (rating: 3)

Also within the construction area, heavy machinery has trampled a 250m stretch of the bank and have crossed the stream in several places.

Recommendation: Construct a temporary crossing.

K134-M31-TD-6-EW (rating: 1)

For approximately 700m there is cattle access to the stream. Parts of the streambank have been trampled and compacted.

Recommendation: Fence to restrict the cattle access.

K134-M31-TD-7-EW (rating: 3)

To the north of the 19th sideroad (King) is a 5m by 5m square area through which the stream flows that is fenced on three sides. The downstream side opens into a pasture. A small wooden dam has been built across the stream, which the stream now flows around. One meter to the east of the stream a trench 0.6m deep and 0.3m wide has been dug. Along the west bank for 30m there is extensive cattle trampling. Upstream of this site is a bent culvert that is now 1.5m high and 1.1m wide.

Recommendation: Construct a proper cattle watering station and regrade and revegetate the area on the west bank that has been trampled.

K156-M31-TD-8-EW (rating: 1)

For approximately 350m cattle have direct access to the stream. The banks have been trampled.

Recommendation: Restrict the cattle access and construct a proper cattle crossing.

K156-M31-TD-9-W (rating: 2)

At this site sheet erosion of a field adjacent to the west bank is the problem. The eroded material is not being held back by the 0.3m wide buffer strip. The erosion extends for 0.5m along the shoreline and is 0.5m high on the bank.

Recommendation: Make the buffer strip wider and revegetate the eroded area.

K156-M31-TD-10-W (rating: 1)

At this site is a gully 6m in length, 1.2m wide and 1m deep. The gully has limited vegetation. Upstream from this gully the stream has been dredged for approximately 60m.

Recommendation: Revegetate the gully to limit the velocity of the runoff and reduce the erosion.

K156-M31-TD-11-EW (rating: 2)

East of the 10th line (King) for approximately 25m is an area of cattle access. Also along this stretch of the stream is some undercutting. This undercutting is mainly on the west bank. The east bank is undercut only at a bend of the stream and in an area downstream from the culvert at this site.

Recommendation: Regrade and vegetate the areas of undercutting. Fence off the stream and construct a proper cattle crossing.

HOLLAND RIVER
TRIBUTARY E

K175-J2-TE-1-W (rating 1)

Within 10m of each other are a couple of gullies that are the result of runoff from adjacent recently worked farm fields. The worst of the two was responsible for large sediment deposits in the stream at the mouth of the gully. This gully was 1m wide at the stream and extended back 30m into the field.

Recommendation: Increase in the width of the buffer strip. Investigate the feasibility of establishing a grassed waterway.

K174-J2-TE-2-EW (rating 4)

The stream flows through a dump at this site. Both banks have been regraded and are 4.6m high. The banks and the adjacent lands are bare.

Recommendation: Clean up this site and seed the banks to hold the bare soil.

HOLLAND RIVER
TRIBUTARY F

K155-J7-TF-EW (rating 1)

At this site the stream widens to form a small pond. At the point where the stream leaves the pond it is obstructed by fallen trees and an old culvert which the stream has cut around.

Recommendation: The obstructions should be removed to prevent the stream from cutting further into the banks.

K155-J7-TF-2-E (rating 1)

At the bend in the stream is a 6m stretch of undercutting of the 3m high east bank and deposition is occrring along the west bank. There is also erosion due to a tile outlet approximately 2m upstream.

Recommendation: Regrade and line the east bank with riprap. Install a proper drainage outlet.

K155-J7-TF-3-E (rating 2)

A section of the stream to the east of the 11th concession has been dredged and the excavated material has been piled on the banks. There is also a gully 6.1m long, 1m deep and 2m wide within this section.

Recommendation: Monitor this site to ensure that the grasses now growing in the gully will prevent the gully from increasing in size.

K155-J7-TF-4-W (rating 2)

Slumping is present for approximately 18m on the 3m high west bank. The bank drops at a 90 degree angle to the stream. The bank is covered approximately 50 percent with tall grasses and has a 2m wide buffer strip.

Recommendation: Regrade the bank to decrease the angle and seed to establish complete cover the bank.

K154-J7-TF-5-W (rating 1)

Many small gullies lead into the stream as a result of runoff from the fields. One of the larger gullies is approximately 2m long, 0.3m wide and 0.3m deep.

Recommendation: Fill the gullies and construct berms to reroute the runoff to a protected inlet structure.

K154-J7-TF-6-EW (rating 1)

The stream channel widens from 1.5m to 8m across a low area approximately 10m long. The erosion problem here is that each rivulet is creating its own channel and increasing the area being eroded.

Recommendation: Dredge a channel to consolidate the flow.

K154-J7-TF-7-EW (rating 3)

This site has two erosion problems. There is extensive cattle trampling along a 250m stretch of the stream and a culvert has been crushed on the south side by heavy machinery. On the north side, timbers have partially blocked the mouth of the culvert. These conditions have resulted in the stream's course being diverted around the obstructions.

Recommendation: Fence the stream and constuct cattle watering stations. Remove the timbers and repair or replace the culvert.

K154-J7-TF-8-EW (rating 4)

Heavy machinery has trampled both banks at this site. Both banks have been completely torn down for a length of 5m on either side of the creek. The soil and rocks churned up by the machines is causing the water to back up.

Recommendation: Install a culvert, regrade and seed the banks.

K154-J7-TF-9-E (rating 3)

Extensive undercutting for 12m has caused the uprooting of three trees. These trees are creating an obstruction that is diverting the stream.

Recommendation: Remove the trees, regrade and revegetate the east bank.

K154-J7-TF-10-W (rating 3)

This site is a gully erosion problem. The gully is 20m long, 1m deep and stretches for 5m along the west stream bank.

Recommendation: Construct check dams to encourage deposition of sediment and the establishment of vegetation.

K154-J7-TF-11-W (rating 1)

At this site there is an obstruction consisting of a fence, logs and rocks. The obstruction has caused the stream to erode into the banks forming a new channel.

Recommendation: The rocks and logs should be removed and a seasonal fence should be installed. The fence should be removed during periods of high flow.

HOLLAND RIVER
TRIBUTARY G

K89-J9-TG-1-W (rating 1)

At this site the west bank has been trampled by sheep and cattle. The erosion problem site extends for 3m along the stream. This site is located 60m east of the concession road.

Recommendation: Fence the stream and construct a crossing/watering station.

K89-J9-TG-2-E (rating 1)

There is livestock trampling at this site beside the culvert, 45m from the concession road. The culvert is 1.5m in diameter and is flattened on top. On the west side of the lane the culvert is causing a back-up of debris.

Recommendation: Repair or replace the culvert to prevent further erosion caused by the collapse of the culvert and back-up of water. The stream should be fenced off to eliminate trampling.

K89-J9-TG-3 (rating 1)

A 2m diameter culvert that runs under the concession road has been installed too high for the downstream water level. As a result, the water drops 20cm out of the downstream end and is eroding the bed of the stream. On either side of the culvert, gullies caused by runoff from the road have cut into the bank. There is also a manure pile 30m from the stream.

Recommendation: Build a rock shute under the outlet of the culvert. Fill the gully and seed the bank. Remove the manure pile to a proper storage facility.

K89-J9-TG-4-W (rating 1)

Trampling of the banks has occured due to livestock access to a 250m stretch along the stream at this site west of the concession road. The west bank of the stream is sparsely

vegetated due to recent dredging.

Recommendation: Fence the stream and construct a proper livestock crossing/watering area. Seed the banks.

K88-J9-TG-5-EW (rating 1)

Approximately 1 km west of the concession road is an area of undercutting on the east bank of the stream. The affected area extends for 60m along and 30cm up the bank. The stream is filled with vegetation and silt.

Recommendation: Remove the bank material and regrade and line the banks with vegetation.

K88-J9-TG-6-EW (rating 2)

Sediment is being deposited at the mouth of the drainage ditch that enters the main stream from the adjacent fields. Entering at right angles to the stream is a gully caused by runoff from the fields of the horse farm. The gully is 8m long and 1m deep.

Recommendation: Regrade and seed the banks of the drainage ditch. Fill the gully and construct a drop structure to accommodate the runoff.

K88-J9-TG-7-EW (rating 2)

A 250m stretch of the stream that has been dredged. There is no vegetation growing on the banks or on the dredging piles.

Recommendation: This area should be revegetated to hold the loose soil.

K88-J9-TG-8-E (rating 1)

For 120m along the stream, the land has been cultivated to the edge of the streambank. As a result, slumping has occurred.

Recommendation: Regrade and seed the banks and establish a buffer strip.

K110-J9-TG-9-W (rating 3)

A drainage ditch enters the stream from the west. The adjacent fields are worked to the edge of the stream. The banks have no vegetative cover or buffer strip and the banks are slumping into the stream.

Recommendation: Regrade and seed the banks. Establish a buffer strip.

K110-J10-TG-10-EW (rating 2)

At the confluence of the two tributaries the banks are bare where the channels have been dredged. There are logs on the west side and a fence has fallen into the stream on the east as a result of slumping.

Recommendation: Seed the banks to hold the bare soil. Remove the logs and relocate the fence.

K110-J10-TG-11-W (rating 1)

A gully on the west bank has been caused by runoff from the adjacent hayfield. The gully is 1m in length, 0.5m wide, and 1m deep.

Recommendation: Fill the gully and construct a drop structure to accommodate the runoff.

K134-J10-TG-12-EW (rating 2)

A 0.3m diameter corrugated steel culvert under a lane between two hay fields is damaged and gullies are forming at both ends of the culvert. Both gullies are approximately 1.2m long and 0.3m deep. Six meters upstream is a fence across the stream.

Recommendation: Replace the culvert or install a grassed waterway. Monitor this site to see if the fence will create

any problem.

K134-J9-TG13-EW (rating 1)

There is a fence obstruction 15m upstream from the bridge at Highway 27.

Recommendation: Replace the present fence with fencing that will not create an obstruction.

K156-J9-TG-14-E (rating 2)

Near the blue barn is a fence obstruction across the stream and undercutting is occurring on the east bank. On the south side of the fence a tile outlet that has been placed too far back from the stream has caused a gully that is approximately 5m long, 1m deep and 1.2m wide.

Recommendation: The fence should be repaired and raised out of the stream. The east bank should be regraded and seeded. The tile drainage outlet should be reconstructed properly.

K56-J9-TG-15-W (rating 1)

The west bank is being undercut for 15m along the bend at this site located downstream from an in-stream pond.

Reccmmendation: Regrade and seed the west bank.

K156-J9-TG-16-W (rating 2)

Along the length of the field are 3 sites of gully erosion caused by seepage. These gullies are 0.5m long, 15cm deep and extend 1.5m along the shore.

Recommendation: Install seepage drains.

K156-J9-TG-17-W (rating 3)

As the stream enters the forest from the south west there is undercutting of the 5m high west bank that extends along the shoreline for 20m.

Recommendation: Line the west bank with riprap.

K176-J9-TG-18-EW (rating 1)

At this site minor erosion of the 8m high banks is due to soil creep and sheet runoff down the steep (80 - 90 degree) banks.

Recommendation: Vegetate the banks with a plant that grows under the dark, dry conditions which are found here. Plants such as coral berry, snowberry, or Virginia rose may be suitable.

K176-J9-TG-19-E (rating 2)

At a site 30m from sideroad 18 (King) a poorly constructed tile outlet on the east bank is causing a gully. The gully is 3.1m long, 0.3m deep and 0.6m wide.

Recommendation: Construct a proper tile outlet.

HOLLAND RIVER
TRIBUTARY H

K111-J28-TH-1-EW (rating 1)

For approximately 350m along the streambank there is minor undercutting in the streambends.

Recommendation: Regrade and vegetate the slopes where necessary.

K111-J28-TH-2-EW (rating 1)

At this site, streamflow has been obstructed by logs. This may result in an erosion causing diversion during times of high flows.

Recommendation: Clear out the logs.

K135-J28-TH-3-E (rating 2)

There is undercutting on an 8m stretch of the east bank of the stream. The erosion is due to a treefall that has caused the stream to flow around it. Also at this site there is a 15m long gully that is 1.4m deep.

Recommendation: Clear out the obstuction, fill the gully, and construct a drop structure to convey the runoff to the stream.

K135-J28-TH-4-W (rating 2)

Spring water is emerging from the bank 1m up the 1.5m high west bank. Soil is being eroded from the discharge area.

Recommendation: Install seepage drains.

K135-J28-TH-5-EW (rating 2)

At this site there is undercutting of the 1.8m high east bank for 8m along the shoreline. The undercutting isoccurring on

the bend of the stream. Upstream and downstream from this bend, there are log jams.

Recommendation: Regrade and vegetate or riprap the east bank. Remove the log jams.

K135-J28-TH-6-EW (rating 3)

At this site the stream is forced to flow around a major log jam, undercutting the east bank of the stream.

Recommendation: Clear out the log obstruction and regrade and revegetate the east bank.

K135-J28-TH-7-E (rating 1)

This site is located at the bridge crossing the stream on the 8th Concession near Pottageville. The bend of the ditch that runs along the east side of the 8th Concession is being eroded as the water drops into the stream.

Recommendation: Construct a rock shute or a drop structure at the mouth of the ditch.

K135-J30-TH-8-W (rating 2)

A gully that cuts 2.1m into the 2.3m high west bank enters the ditch at the road side (Concession 8). The gully cuts 60m into a field west of the concession. The mouth of the gully is 6m wide.

Recommendation: The installation of check dams and a vegetative lining may keep the gully from enlarging.

K158-J30-TH-9-E (rating 1)

The east bank of the stream is the site of regrading. Bulldozers and tractors have trampled the banks and adjacent land. The newly dredged channel is 1.2m wide, 1m deep and contains 15cm of water. The banks are bare of all vegetation. Upstream is a set of fences that cross the stream. At the present water level, the fences do not

create obstructions.

Recommendation: Seed the banks to stabilize the bare soil.

K158-J30-TH-10-EW (rating 2)

At this site there are 2 corrugated steel culverts passing under a farm driveway. The culverts are about 7m apart. The west culvert is the underpass for the stream. Gullies are forming down the sides of both culverts. There is also slumping of the west bank due to water flowing into the stream from a ditch that runs parallel to the driveway. Originally, the east culvert was in the path of the stream, however, the channel has been rerouted to the west culvert.

Recommendation: Fill the gullies and line the banks with riprap. The slumping can be eliminated by grassing the banks of the ditch at its mouth.

K158-J30-TH-11-EW (rating 1)

At this site there is a tree and fence obstruction across the watercourse.

Recommendation: Remove the tree, relocate the fence so that it no longer catches floating debris.

K135-U5-TH-12-E (rating 1)

West of the bridge on the 8th concession, south of the Lloydtown Road is a gully 15cm wide and 15cm deep cutting back into the trees on the east bank. The gully meets the stream at the site of a log jam caused by fallen cedar trees and stumps. The gully is completely vegetated and there is little erosion of the 1.2m high east bank.

Recommendation: Clear out the log jam.

K135-U5-TH-13-E (rating 2)

Undercutting of the 1m high east bank at a bend in the stream has caused several cedars to fall across the stream.

The undercutting extends for about 4m along the steep (90 degree) east bank. Adjacent to the main stream is a smaller stream which may cause a gully as it cuts through the east bank to join the stream.

Recommendation: Remove the cedars, regrade the east bank and line it with vegetation.

K135-U5-TH-14-E (rating 1)

Undercutting for 6m along the east bank has exposed the roots of the trees that provide the bank with its 50% vegetative cover. The 1m high bank is held by these roots.

Recommendation: Regrade and revegetate the east bank.

K135-U5-TH-15-E (rating 2)

A 3m stretch of the east bank is so undercut that there is a 1.2m overhang that may soon slump into the watercourse.

Recommendation: Regrage the bank and stabilize it with vegetation or riprap.

K135-U5-TH-16-E (rating 2)

Slumping of the wet east bank extends around a bend for 6m. There are many log jams throughout this wooded area which cause changes in stream direction. These diversions cause more undercutting and the slumping.

Recommendation: Clear out the obstructions, restabilize the banks with a vegetative lining.

K135-U5-TH-17-E (rating 2)

Undercutting and slumping at this site is the result of the stream being diverted by trees and logs. This area extends for 10m along the one metre high east bank.

Recommendation: Clear the obstuctions and stabilize the east bank.

K157-U5-TH-18-W (rating: 1)

At this site there is a gully that is six metres in length. The mouth of the gully is 1m across and it cuts from the top to the bottom of the 1m high west bank. The gully appears to be the result of water flowing from a spring.

Recommendation: Revegetate the gully to stabilize its banks.

K177-U5-TH-19-W (rating: 2)

At this site, natural slumping has caused the trees on the west bank to fall into the stream. The stream has been diverted and now flows around the trees, undercutting the 1.7m high west bank for 8m.

Recommendation: Clear out the trees and regrade and revegetate the west bank.

K177-U5-TH-20-EW (rating: 4)

At this site there is slumping, undercutting, and a minor log obstruction. The 12m high west bank has slumped for 15m along the shoreline. Trees on this slope have fallen into the stream. On the east bank there is undercutting of the 1.2m high bank. Downstream from this site, more slumping and undercutting affect another bend.

Recommendation: Clear out the logs, regrade and revegetate the banks where necessary.

K177-U5-TH-21-E (rating 1)

Minor undercutting for 4.6m along the bend in the stream is occurring at this site. The erosion extends 1m up the 1.4m high banks. Downstream from this site there is a minor log jam.

Recommendation: Regrade and revegetate the banks and clear out the logs.

K177-U14-TH-22-E (rating 1)

At this site there is natural undercutting of the 0.8m high east bank. The site is found on a bend in the stream. The roots of a tree on the east bank have been exposed. This tree may fall into the stream and cause an obstruction.

Recommendation: Regrade and revegetate the east bank.

K157-U8-TH-23-E (rating 1)

The stream channel is 0.6m wide at this site of undercutting. The affected area is on the east bank at a bend downstream of the bridge at Highway #27. The bank is undercut 0.6m up the 1.2m high bank for 5m along the bend.

Recommendation: Regrade and seed the bank.

HOLLAND RIVER
TRIBUTARY K

67-U15-TK-1-EW (rating 1)

At this site there is a fence obstruction. The fence has has backed up logs and grasses that may cause the stream to divert from its normal path.

Recommendation: Clear out the debris and relocate the fence.

K67-U15-TK-2-EW (rating 1)

Sheets of heavy solid plastic have been placed in front of a small earth dam. The stream has widened in front of the dam.

Recommendation: Clear out the dam.

K67-U15-TK-3-E (rating 2)

Throughout this area the stream meanders and there are sites of undercutting in the bends. At this particular site the 1m high banks are being eroded away for 8m along the shoreline. The roots of a tree on the east bank are being exposed as the soil is washed away. Eventually there will not be enough soil to hold the tree and it will fall into the stream.

Recommendation: Regrade and revegetate the east bank.

K67-U15-TK-4-W (rating 3)

This site is located north of Highway #9 and it is visible from the highway. Sloughing at a bend of the stream affects approximately 6m of the 1.8m high west bank. There is also undercutting of the lower portion of the slope.

Recommendation: Regrade and revegetate the west bank.

HOLLAND RIVER
TRIBUTARY L

K56-J17-TL-1-EW (rating 1)

South of the gravel pit is a site of cattle trampling.

Recommendation: Fence the stream and construct a cattle watering station.

K56-J17-TL-2-EW (rating 4)

At this site there is a severe log obstruction where an old elm tree has been cut down. The 1m high bank around the remaining tree stump has been eroded.

Recommendation: Clear the obstruction.

K56-J17-TL-3-E (rating 3)

The 70 degree angle of the 4m high bank combined with cattle trampling has caused the slumping of the east bank. The affected area extends along the bank for approximately 8m.

Recommendation: Stabilization of the east bank could be achieved by regrading the bank and establishing a vegetative cover.

K56-J17-TL-4-W (rating 1)

Minor undercutting occurs on the west bank along this winding stretch of the stream. The problem extends for approximately 120m as the stream meanders through the flood-plain.

Recommendation: Regrade and vegetate where necessary.

K68-J17-TL-5-EW (rating 2)

Cattle and farm equipment have trampled the banks crossing the stream. The 1.3m high banks have been broken down for a

distance of 4m along the stream. Further downstream is more cattle trampling.

Recommendation: Fence the stream and construct a proper crossing/watering area.

K69-J17-TL-6-W (rating 5)

At this site north of Highway #9, the angle of the bank is 80 degrees and the 20% vegetative cover consists of grasses and trees. There is undercutting and slumping caused by livestock trampling. There is also a gully cutting in to the west bank that is 2.7m long, 2m deep and 2.7m wide at the streambank.

Recommendation: Regrade and seed the bank where necessary. Fence the stream and construct a cattle crossing/watering station. Fill the gully and construct a proper inlet structure for runoff from the pasture.

K69-J17-TL-7-E (rating 3)

Thirty meters north of Highway #9 is a site of undeructting that extends for 8m along the east bank. The bank is 1m high and is eroded to the top. There is some trampling of the banks in this area caused by cattle.

Recommendation: Fence off stream, regrade and revegetate the east bank.

K69-J17-TL-8-EW (rating 2)

Cattle that have access to the stream north Highway 9 have trampled the banks on both sides of the stream. The affected area extends for 4m along the shore.

Recommendation: Fence off stream and allow access only at a properly constructed crossing and watering station.

K69-U12-TL-9-EW (rating 2)

The banks near the corrugated steel culvert are eroding due

to cattle trampling. There are also two bare cattle paths on the surrounding high hills. This site is located in a very hilly area along the 4th concession. Throughout this area, the stream is rarely more than a meter wide.

Recommendation: Restrict cattle access to this area.

K77-U12-TL-10-EW (rating 1)

Water flowing around several large rocks is eroding the streambed and the 1m high banks.

Recommendation: Remove the rocks that are creating the problem.

K77-U12-TL-11-EW (rating 1)

Gullies adjacent to the 1.2m diameter culvert beneath the 19th sideroad are due to road runoff. The gullying extends 3.6m to the top of the bank. The downstream end of the culvert is approximately 20cm above the water level and water dropping out of the culvert is eroding the streambed.

Recommendation: Fill the gullies and stabilize the banks with vegetation or rip rap. Construct a rock shute at the end of the culvert.

KETTLEBY CREEK
MAIN STREAM

K55-J21-1-1-EW (rating 2)

A log obstruction is located south of the wooded area adjacent to the canal. Also in this pasture 120m further upstream, there is a cattle crossing. The farmer has covered all the access points with gravel which has reduced the erosion, but the banks are still being trampled.

Recommendation: Remove the log obstruction. Reconstruct the cattle crossing and seed the banks to stop the erosion.

K68-J21-1-2-EW (rating 4)

At this bend in the stream there is extensive undercutting for 30m along the 2m high banks. There is a log jam on the west bank of the bend causing an obstruction. Several trees may slump into the stream if the undercutting continues.

Recommendation: Regrade and seed the banks.

K68-J21-1-3-EW (rating 2)

An obstruction of logs has caused the stream to pool. This has widened the stream from the average 2m width to approximately 5m. A small falls has cut into the streambed below the obstruction. Downstream of the obstruction the stream widens as a result of undercutting extending 1.2m up the bank and 6.1m along the shoreline of the west bank. Upstream of the obstruction is a cattle crossing which has been lined with gravel. The banks are trampled and the gravel has washed downstream into a deeper area.

Recommendation: The log obstruction should be removed and the cattle crossing repaired. The banks at this crossing should be graded back and gravelled to the top of the banks.

K68-J21-1-4-E (rating 4)

At the streambend on the edge of the wooded area the 1.5m high east bank has been undercut. Several trees fell when

the bank slumped into the stream. This undercutting has widened the stream to 3.5m. The erosion extends along the east bank for 11m.

Recommendation: The logs should be removed and the east bank stabilized by regrading and lining with riprap or vegetation.

K68-J21-1-5-EW (rating 1)

Undercutting is responsible for this obstruction of logs and slumped clumps of grassy bank.

Recommendation: Remove the logs and bank material. Regrade and revegetate the banks.

K68-J21-1-6-E (rating 2)

Extending for 12m the 1.5m high east bank is undercut. The bank is 50% covered with grasses and cedar trees. The stream here is about 3m wide. Although there is cattle access no trampling is noted.

Recommmendation: Regrade the east bank. The cedars on the banks don't hold the soil very well and should perhaps be replaced with some smaller shrubs.

K68-J21-1-7-EW (rating 3)

This site is located north of Highway #9 where the stream enters the trees. The banks of the stream rise 2m at an angle of 70 degrees and are 50% vegetated with grasses. Cattle have trampled a 2.4m wide section of the bank on either side of the stream. The land owner has dumped a load of gravel to protect the stream bottom.

Recommendation: Regrade and reline the banks with gravel.

K68-J13-2-1-W (rating 2)

At this site there is a gully that is over 6m in length and 1m deep. There is water in the gully for most of its

length.

Recommendation: Fill the gully and contruct a surface diversion or drop structure to accommodate runoff from the adjacent area.

K68-J13-2-2-W (rating 3)

At this site there is the undercutting of the stream's west bank. The undercutting extends for 6m along the shoreline and 1.5m up the bank.

Recommendation: Regrade the west bank and line it with riprap.

K68-J13-2-3-EW (rating 1)

A fence crossing the stream is collecting floating debris that may build up and cause a diversion.

Recommendation: Clear out the debris and raise the fence.

K68-J13-2-4-W (rating 3)

At this site slumping has been caused by the undercutting of the lower portion of the bank. The undercutting occurs naturally as the stream flows around a bend.

Recommendation: Regrade the bank and place riprap along the bend.

K68-J13-2-5-E (rating 4)

The undercutting at this site extends for 15m along a bend of the stream. The erosion affects all of the 1.2m high east bank. Much of the sediment from this site has been washed away and only large rocks are visible at the base of the streambank.

Recommendation: Construct groynes in the bend or regrade the bank and place riprap along the bend.

K68-J13-2-6-W (rating 4)

The undercutting at this site extends for 6m along a bend of the stream. The height (2.4m) and the angle (90 degrees) of the bare bank make this a major problem site.

Recommendation: Construct groynes in the bend or regrade the bank and place riprap along the bend.

K68-J13-2-7-E (rating 5)

The slumping that is occuring at this site has been caused by natural undercutting as the stream flows around a bend. The undercutting extends for 15m and affects the entire height of the bank (1.1m). This problem is compounded by a 90 degree slope and the lack of a vegetative cover.

Recommendation: Construct groynes or regrade the bank and place riprap along the bend.

K68-J13-2-8-E (rating 5)

The natural undercutting along the bend at this site has been considered severe due to the length of the affected shoreline (15m) and the height of the bank (1.4m). The 90 degree slope and the small amount of vegetative covering compound the problem.

Recommendation: Construct groynes or regrade the bank and place riprap along the bend.

K68-J13-2-9-E (rating 5)

At this site there is a gully that is 3.3m long, 3.0m deep and 1.5m wide. The sides of the gully are very steep and trees are the only vegetative lining. Some of the smaller trees have already fallen into the gully and there are more trees in danger of doing so. This gully cuts into the bank on a bend of the stream.

Recommendation: Fill the gully and stabilize the bank with riprap. Construct a drop structure for runoff from the

adjacent land.

K68-J13-2-10-E (rating 5)

At this site there is slumping for 6m along the 1.2m high east streambank. The slumping has been compounded by farm equipment that has been driven on the top of the streambank. The slope has an 80 degree angle and is completely bare of vegetation.

Recommendation: Build a gabion basket retaining wall along the streambank and move the tractor path further away from the streambank.

K75-J13-2-11-E (rating 3)

Natural undercutting affects 12m of the 1.2m high east bank at this site upstream of a small pumphouse.

Recommendation: Regrade and line the bank with vegetation or riprap.

K75-J13-2-12-E (rating 3)

An oxbow formation is being created at this site. During periods of high flow a new channel is being cut straight across a meander. During periods of low flow the stream follows its regular course.

Recommendation: Straighten the streamcourse by excavating and lining a new channel.

K75-J13-2-13-E (rating 5)

The undercutting at this location occurs in a bend of the meandering stream. A large piece of the bank has fallen into the stream. The water flowing along the east side of the stream continues to undercut the bank.

Recommendation: Construct groynes in the bend or regrade the bank and place riprap along the bend.

K115-J15-3-1-E (rating 2)

At this site undercutting extends along the east streambank for 15m affecting all of the 2m high bank. There is also a minor log obstruction.

Recommendation: Remove the logs and debris. Regrade and line the banks with riprap or a vegetative cover.

K115-J15-3-2-W (rating 3)

A 300mm diameter drainage culvert flows into a 7m long gully on the west bank at this site. Broken concrete slabs have been dumped into the gully to reduce the erosion of the 2m high banks.

Recommendation: Lengthen the culvert and arrange the pieces of concrete into a shute to reduce bottom erosion.

K115-J15-3-3-E (rating 2)

Ground water seeping through the banks has eroded a key-hole shaped gully on the east side of the stream. Located beside a footbridge and a drop structure, this gully is 2.5m long and 0.5m deep.

Recommendation: Install seepage drains.

K115-J15-3-4-EW (rating 4)

Advanced undercutting and slumping affect a 30m stretch of the stream. Located between two wooded areas, the 2m high banks on a large bend in the stream have been eroded.

Recommendation: Regrade the banks and line the bend with riprap.

K115-J15-3-5-EW (rating 4)

Downstream from the point where a small tributary enters the stream from the east there is severe undercutting on the west bank of the stream. There is an old cattle crossing that extends for 4m on both sides where the banks slope gently to the stream. There is an area of slumping on the east side of the stream that affects the land 6m from the edge of the stream. The total length of this erosion site is 15m.

Recommendation: The undercut slopes should be regraded and revegetated. The cattle crossing area needs only to be seeded to hold the soil on the banks.

K115-J15-3-6-W (rating 1)

A log obstruction of logs is causing the stream to change course and cut into the west bank. Clumps of earth and grass have been separated from the bank by the stream.

Recommendation: Remove the logs, regrade and seed the west bank of the stream.

K115-J15-3-7-W (rating 2)

This gully is caused by runoff from the adjacent field. The gully is 15m long, 1m deep and is vegetated withe grass. The gully breaks up into many small gullies as it enters the stream along a 4.6m stretch of the west bank.

Recommendation: Use conservation tillage methods on the field and/or install check dams along the gully.

K115-J15-3-8-W (rating 3)

Undercutting affects 10m of the west bank along the outside of the bend. Rocks have accumulated at the bottom of the undercut slope.

Recommendation: Regrade the west bank and line the bend with riprap.

K115-J15-3-9-W (rating 2)

Undercutting and slumping of the 1m high west bank affect 4m of this streambend. Sediment has been deposited on the east bank at the waters edge. The meander is beginning to migrate west.

Recommendation: Regrade the west bank and line the bend with riprap.

K115-J15-3-10-W (rating 1)

The undercutting at this site extends for 2m along and 0.5m up the 1m high west bank.

Recommendation: Regrade and vegetate the west bank.

K139-J15-3-11-W (rating 1)

Undercutting is the problem at this site near a barn 120m north of concession 19 of King Township. The problem affects a 2m stretch of the streambend, 0.6m up the 1m high west bank.

Recommendation: Regrade and vegetate the west bank.

K139-J21-4-1-EW (rating 1)

Bricks and rocks have been placed in the 1.8m wide stream. The water is flowing over and around the bricks and rocks and a small waterfall. This site is located south of the 18th sideroad (King). Upstream from this site, trees have fallen into the stream.

Recommendation: Clear out the obstructions to prevent the diversion of the stream.

K139-J21-4-2-EW (rating 2)

This site is located between the enterance of a small tributary and a footbridge. There is a small amount of

undercutting at the base of the footbridge on the west bank. Upstream from the bridge there is undercutting for 5m along and 0.5 up the 1m high east bank. This erosion affects the bend of the stream and sediment is deposited on the west bank of the bend.

Recommendation: Regrade and revegetate the banks.

K139-J21-4-3-EW (rating 2)

At this site water droppping over a log obstruction is eroding the downstream channel.

Recommendation: Remove the obstruction.

K139-J21-4-4-W (rating 5)

At this site there is severe undercutting of the 8m high west bank for 15m along the bend of the stream.

Recommendation: Regrade the west bank and line the bend with riprap.

K139-J21-4-5-EW (rating 5)

At this site there is severe erosion of the 10m high banks for 20m on both sides of the stream. The bank has eroded approximately 5m in from the edge of the stream. There were two fences 3m apart on the top of the east bank, however, the fence nearest the stream has fallen down the bank. The second fence is 0.3m from the edge of the eroded slope.

Recommendation: Regrade the banks or construct gabion basket retaining walls.

K139-J21-4-6-E (rating 4)

The problem at this site is the slumping of the 5.5m high bank for 25m along the shoreline. The site is found on the east bank in the bend of the stream.

Recommendation: Regrade the east bank and line the bend

with riprap.

K139-J21-4-7-E (rating 5)

A large gully is found along the stretch referred to in K139-J21-4-6-E. The gully is 8m in length and 4.5m deep. There is grass growing in the lower portion of the gully. The banks of the gully are bare in the upper portion. Runoff from a nearby farm field appears to be the cause of the gully.

Recommendation: Fill the gully and regrade the area or construct check dams in the gully to prevent further erosion.

K162-J20-4-8-W (rating 1)

At this site, located south of the small cottage at the end of Spruce Road, a rock obstruction is diverting the stream around the cottage`s back yard and under a newly constructed foot bridge. There is some minor undercutting of the bare west bank where the rocks are piled.

Recommendation: Construct a groyne to divert the stream. Monitor the site to determine if it will be necessary to protect the east bank.

K162-J20-4-9-EW (rating 1)

A log jam is changing the course of the stream, causing the stream to carve a new channel.

Recommendation: Remove the obstruction.

K162-J20-4-10-W (rating 2)

This site is 30m north of King Hills Lane. The stream meanders through cedar woods and, at this point, it flows around a 90 degree bend in a distance of 3m. Undercutting affects the 1.3m high west bank.

Recommendation: Regrade the bank and line the bend with

riprap or excavate a less severe bend.

K162-J20-4-11 (rating 1)

At the point where the stream crosses King Hills Lane, between the 17th and 18th sideroads, there is a 1.5m round concrete culvert. The water flowing out of the culvert drops 1m to the stream on the north side.

Recommendation: Install a rock shute or a drop structure on the north end of the culvert where the water is eroding the stream bed.

K182-J20-4-12 (rating 1)

Approximately 65m north of Sideroad #17, there is a large in-stream pond which is not found on the 1975 King aerial photographs. Upstream from the pond there are many cedar trees that have fallen across the stream. These obstructions may cause stream diversions.

Recommendation: Remove the obstructions.

KETTLEBY CREEK
TRIBUTARY C

K139-U18-TC-1-W (rating 3)

At this site there is natural undercutting of the 1.2m high west bank for 8m along the bend of the stream. Upstream approximately 15m there is a similar site. The undercutting of the 1.2m high bank is also found on the bend of the stream as it meanders through the area.

Recommendation: Regrade the bank and line the bend with riprap or vegetation.

K140-U19-TC-2-W (rating 5)

Severe gullying is the problem here. There are several branches of the 30m long main gully. The banks that these gullies are eroding are 2m high. The cedar trees on the banks of the gullies have their roots exposed and may soon fall. Nearby (to the south of this site) there is an old gravel pit that is now full of water. There is a small roadway that divides the gravel pit into a large and a small pond. The small pond is closest to the stream. In the corner of this pond there is a 0.3m diameter culvert that releases water to the stream. On the side of the ponds bank where the culvert exits is another large gully. It is approximately 30m long and 4m deep. This gully is 100% covered in grass and appears to be stable.

Recommendation: Fill in the first gully and revegetate the area. Monitor the second gully in order to determine if the present vegetation is sufficient to prevent further erosion.

K140-U19-TC-3 (rating 1)

The stream along this stretch has cut deeply into its bed. There are many rocks in the stream but very little sediment.

Recommendation: Install energy dissipating check dams.

K140-U19-TC-4-E (rating 3)

At this site there is undercutting for 8m along the east

bank of the stream. Only 1.2m of the 2m high banks is being eroded.

Recommendation: Regrade the slope and place riprap along the bank.

K140-U19-TC-5-EW (rating 1)

At this site there is a rock obstruction across the 1m wide stream. The large rocks and the logs here have been purposely placed here for vehicles to cross the stream.

Recommendation: Remove the rocks and logs and install a culvert.

K116-U19-TC-6-EW (rating 1)

At this site there are two fences 8m apart running the length of a farm field. There is an exposed concrete culvert lying in the path of the stream. This was once a cattle crossing but now the cattle can cross anywhere along this section of the stream.

Recommendation: Reconstruct the cattle crossing.

K116-U19-TC-7-EW (rating 2)

This site is a large area that cattle have trampled. The most severe part of this site is located just south of the 18th sideroad where what used to be the main stream is now a cattle path.

Recommendation: Fence the stream and construct a proper cattle crossing/watering station.

K139-U18-TC-8-W (rating 3)

At this site, 1m of the 1.2m high bank has been undercut for 6m along the west bank. The site is found in the bend of the stream. Parts of the bank that have been undercut have fallen into the stream.

Recommendation: Regrade the west bank and place riprap along the bend.

K139-U18-TC-9-EW (rating 1)

There is a log jam at this site.

Recommendation: Clear out the logs before the stream is forced to flow around them and cut into the banks.

K140-U18-TC-10-EW (rating 1)

At this site the stream splits up into a number of smaller channels. One channel has a 0.3m vertical drop and the streambed has cut back along the bed.

Recommendation: Reroute flow through the other channels or construct a rock shute to protect the streambed.

K140-U18-TC-11-EW (rating 2)

This site is located at the southern culvert under the 4th concession. There are two gullies, one on each side of the stream. The one on the west enters the stream right at the culvert, while the one on the east enters 10m upstream from the culvert. The west gully is the worst of the two, this gully is 6m long and 2.4m deep.

Recommendation: Fill in the gullies and revegetate the banks.

K140-U18-TC-12-EW (rating 2)

The banks are being eroded as the stream flows around concrete rubble and a 0.3m diameter corrugated steel culvert that lies partly in the stream and partly on the bank.

Recommendation: Remove or reconstruct the crossing.

POTTAGEVILLE CREEK

U136-U7-1-EW (rating 3)

At this site the 1.1m high east bank is undercut for 8m. There are two fences which cross the stream on this meander that are in danger of falling into the stream.

Recommendation: Regrade and line the east bank with riprap. Relocate the fences and remove the fallen trees.

K159-U7-2-E (rating 1)

The 0.6m high east bank is being eroded by sloughing and slumping. Several trees have fallen into the stream.

Recommendation: Remove the trees, regrade and vegetate the east bank.

K159-U7-3-E (rating 2)

At this bend in the stream the 1.2m high east bank has been undercut for 5m. Roots of trees that hang over the east bank have been exposed by the erosion. The stream has widened from its usual 1m width to 4m in this section.

Recommendation: If access to this site in this heavily wooded area is feasible, regrade and vegetate the east bank.

K180-U7-4-EW (rating 1)

The streambanks are subject to slumping and treefalls throughout this swampy area. The area stretches for approximately 1km from south of Happy Valley to the 17th Sideroad.

Recommendation: Line the banks with stabilizing vegetation.

GLENVILLE CREEK

K45-U20-1-W (rating 1)

A this site there is natural undercutting of the 0.6m high west bank for 3m. The erosion occurs at the bend of the stream. Roots of trees are being exposed as the soil around them is washed away.

Recommendation: Regrade and revegetate the west bank.

K45-U20-2-EW (rating 1)

South of the gravel pit there is sloughing of the 5m high east bank of the stream. The erosion affects 8m of the bank along a bend in the stream. Downstream, fallen trees are causing both banks of the stream to be eroded.

Recommendation: Regrade the east bank and place riprap along the bend. Clear out the fallen trees.

K45-U20-3-EW (rating 3)

In this area the farmer has used an electric fence to restrict cattle access to a part of the stream creating a cattle watering station. Both banks are trampled at the watering station as this site is used as a cattle crossing area when the farmer moves the cattle across the stream to other fields. Downstream of the footbridge is slumping of the 1.2m high banks due to more cattle trampling.

Recommendation: Limit cattle access strictly to the area of the crossing/watering station and line the banks with gravel.

K45-U20-4-EW (rating 1)

At this site there is a small dam across the 0.5m wide stream. It appears that, during high flows, water flows around the dam. Gullies are beginning to form on both sides of the dam. The area is fenced off from the adjacent pasture.

Recommendation: Fill the gullies and vegetate the banks. Be

sure to remove the stop logs from the dam during high flows to prevent overtopping.

K45-U20-5-W (rating 1)

Slumping of the upper portion of the 1m high west bank is caused by undercutting of the lower portion. This site is found on a bend of the stream.

Recommendation: Regrade and revegetate the west bank.

K45-U20-6-EW (rating 2)

This site is located beside the culvert beneath the 3rd concession. A gully on the east bank immediately beside the concrete box culvert is 1.5m deep and 2.1m long. Upstream 3m, a gully that starts at the roadway enters the stream through the west bank. Both of these gullies have probably been caused from runoff from the road.

Recommendation: Fill the gullies and vegetate the banks. Construct a drop structure to accommodate the runoff.

K46-U20-7-EW (rating 1)

A footbridge has been washed out and is now lying in the stream. There are signs of animals and motorbikes crossing the stream here. Immediately downstream, the unprotected west bank is being undercut.

Recommendation: Rebuild the bridge. Regrade and vegetate the bank where undercutting occurs.

K46-U20-8-EW (rating 1)

This site is located at the downstream end of a large in-stream pond north of Highway #9. There are 2 culverts under the path at the end of the pond. Water from the concrete culvert drops 15cm to the stream. Water from the corrugated steel culvert drops 1m onto a pile of brush.

Recommendation: Clear out the debris and construct rock

shutes at the outlets of the culverts to prevent erosion of the streambed and banks.

K58-U20-9-EW (rating 5)

This site is located in Glenville at the 1m diameter corrugated steel culvert beneath the first road north of Highway 9. The water flows through the culvert and drops 1.2m before splashing the rocks and logs below. The water is undercutting the 2.4m high west bank as the stream bends eastwards. This undercutting stretches for 10m along the streambank.

Recommendation: Construct a proper drop structure at the outlet of the culvert, regrade the west bank and line the bend with riprap.

HOLLAND RIVER EAST BRANCH
MAIN STREAM

N1-U21-6-1-W (rating 2)

This site is located south of the swing bridge on Green Lane. There is a gully here that is 8m long, 0.3m deep and 0.6m wide. The ground within the gully is bare, but the surrounding area is grassed.

Recommendation: Fill the gully and revegetate the west bank.

N1-U21-6-2-W (rating 2)

The gully at this site is approximately 21m long, 2m wide and 1.2m deep. The banks of this gully are protected as there is grass growing on them. There is water in the gully.

Recommendation: Regrade and revegetate the west bank.

N2-U21-6-3-E (rating 3)

This site is located near the sewage treatment plant. There is undercutting of the 2m high east bank for 6m. The undercutting has caused part of the bank to collapse into the stream.

Recommendation: Regrade the east bank and line the bank with vegetation or riprap.

N2-U21-7-1-W (rating 2)

At this site there is a gully that starts near the railroad tracks to the west of the river. There is a dirt path between the river and the railway tracks. A culvert has been placed on the path in the gully. The gully is 1.2m deep, 1.6m wide and has grass growing in it.

Recommendation: Fill the gully and revegetate the bank.

N3-U21-7-2-W (rating 4)

The 2m high west bank is undercut at the point where Tributary A (Western Creek) joins the mainstream. The water flowing from this tributary passes through 2 corrugated steel culverts and drops 0.6m to the water level of the main stream. The falling water is cutting back into the soil around the culverts. There is also undercutting along the shoreline upstream from the culverts.

Recommendation: Regrade and revegetate the west bank. Construct a rock shute or drop structure at the outlet of the culverts.

N3-U21-8-1-E (rating 3)

The outflow of a culvert draining the adjacent lumber yard is creating an erosion problem. The culvert discharges at the top of the 2m high east streambank and runoff is cutting a gully as it flows down the bank.

Recommendation: Construct a proper drop structure.

N3-U21-8-2-E (rating 1)

This gully is located upstream from the Queen Street bridge. The gully is 1m deep and 4.5m long. The gully is caused by runoff from the road.

Recommendation: Fill the gully and revegetate the east bank. Build a drop structure to accommodate the runoff.

TOPO-U29-9-1-EW (rating 2)

This site of undercutting is located at a point where a minor tributary enters the main stream from the east. Cattle have access to the stream here. The top parts of the banks have slumped due to the undercutting and trampling.

Recommendation: Regrade and revegetate the banks. Fence to restrict cattle access to the stream.

TOPO-U29-9-2-EW (rating 2)

Both banks have been trampled by farm machinery traversing the stream. Vehicles crossing at this point have to travel in the stream for 10m before they can exit the stream on the other bank. Upstream and downstream of this site there is minor undercutting in the bends as the stream meanders through the area. Upstream of this site a fence has fallen into the stream.

Recommendation: Construct an appropriate crossing, regrade and vegetate the banks where necessary, and relocate the fence.

TOPO-A8-9-3-EW (rating 3)

Farm tractors crossing the stream have trampled the banks. The bare 1.2m high banks have been broken down so that they are now at 30 degree angles.

Recommendation: Restrict vehicle access or construct an appropriate crossing.

TOPO-A8-9-4-W (rating 3)

Undercutting at this site affects all of the 1.2m high west bank for 10m along the shoreline. Also at this site a large oak tree has fallen across the stream.

Recommendation: Regrade and revegetate the west bank. Remove the obstruction.

K98-U28-10-1-E (rating 3)

Runoff from the road is resposible for the gully south of the bridge on the St. John's Sideroad. The gully is 2m deep, 4.5m long, and has no vegetative cover.

Recommendation: Fill the gully and line the east bank with vegetation or riprap.

K98-U28-10-2-E (rating 3)

Sloughing affects 6m of the shoreline at this site. The east bank is 2.4m high and is approximately 60 percent covered in grass. A similar site a short distance upstream extends for 6m along a bend in the stream. However, this bank is not as steep.

Recommendation: Regrade and line the east bank with riprap.

K98-U28-10-3-EW (rating 1)

Cattle trampling at this site affects 3m of the streambank. The ground in this area is bare due to the cattle. Upstream is some minor undercutting and slumping due to the cattle trampling.

Recommendation: Fence to restrict cattle access to stream.

K98-U28-10-4-EW (rating 5)

This site extends for approximately 30m along the meandering streambank. The site is located where the stream flows around a bend that has a backwards S shape. Before the first bend is a cattle crossing area. The banks are approximately 2.4m high and have been heavily trampled. Manure is present in the stream. Upstream at the first bend, the west bank is 2.1m high and the outside east bank is 3.7m high. Slumping affects a 10m stretch of the east bank. Upstream on the second bend, undercutting of the 2.4m high west bank is occurring.

Recommendation: Fence to restrict cattle access and construct a proper crossing. Regrade and revegetate the banks affected by slumping.

K98-U28-10-5-EW (rating 1)

At this site cattle trampling is causing the erosion of both banks of the stream.

Recommendation: Fence to restrict cattle access.

K98-U28-10-6-W (rating 3)

The gully at this site is 10m long, 1m wide and 1.2m deep. The ground within the gully is bare of vegetation. The gully is found on the of the west bank of the stream.

Recommendation: Fill the gully and revegetate the west bank.

K98-U28-10-7-EW (rating 3)

Machinery crossing the stream has trampled a stretch that is approximately 4m long on both banks. The 1.5m high banks are at 35 degree angles. Upstream 120m is a culvert in the stream. There is no laneway over the culvert and the stream is cutting around it.

Recommendation: Rebuild the laneway over the stream to prevent the trampling of the banks.

K144-U27-11-1-EW (rating 1)

This site is located just south of Wellington Street in Aurora. Erosion of the 1m high banks has been caused by a vehicle that was driven through the stream.

Recommendation: Restrict access to the stream.

K144-U27-11-2-E (rating 1)

A farm vehicle has broken down the 1m high east bank. This site is found at the point where a small tributary enters the stream.

Recommendation: Restrict vehicle access to the stream.

K144-U27-11-3-W (rating 1)

A gully is starting to form at this site. It is now 3m long, 0.8m wide, and 1m deep. The banks of the gully are covered with grasses.

Recommendation: Fill the gully and revegetate the area to prevent erosion by runoff.

K168-A2-12-1-EW (rating 1)

This site is located north of the Vandorf Sideroad, west of Leslie Street. Undercutting affects the bends of the meandering stream for approximately 250m.

Recommendation: Regrade and vegetate the banks where necessary.

K168-A2-14-1-W (rating 2)

The gully at this site is 20cm deep and 1.5m wide. Runoff from the nearby golf course has transported sediment that is deposited on the east side of the gully.

Recommendation: Fill the gully, vegetate the bank, and construct a rock shute or drop structure to accommodate the runoff.

K168-A2-14-2-E (rating 4)

This site is located south of the Vandorf Sideroad between the Westview Golf Club and Leslie Street. Undercutting affects 25m of the east streambank along a bend. The undercutting only extends 3m up the 8m high east bank. The surrounding area is heavily wooded.

Recommendation: Regrade the bank and install riprap and a gabion basket retaining wall.

K146-A2-15-1-W (rating 3)

This site is located north of the Vandorf Sideroad east of Leslie Street. Cattle have trampled down the 1.1m high banks for 4.5m along the west bank.

Recommendation: Fence to restrict cattle access and construct a cattle watering station.

K146-A2-15-2-E (rating 4)

At this site there is undercutting and slumping of the 3.7m high east bank. The affected area extends for 6m along the bend of the stream.

Recommendation: Regrade the bank and install riprap and a gabion basket retaining wall.

K146-A3-16-1-W (rating 1)

On the west bank of the stream at the 1.2m diameter corrugated steel culvert there is undercutting. There are also concrete blocks and hoses lying in the stream.

Recommendation: Clear out the debris, regrade and vegetate the eroding bank.

K147-A3-16-2-EW (rating 2)

This site is located west of the railroad tracks south of Slater's Road in Vandorf. There is cattle trampling around a small pond that the stream flows through. There is also some slumping along the west bank of the stream (before it enters the pond) due to cattle trampling.

Recommendation: Line the banks of the pond and fence the stream to restrict cattle access.

K125-A3-17-1-EW (rating 2)

This site is located north of the Vandorf Sideroad west of Concession #6. The stream flows along the sideroad as a ditch and enters a swampy area. Cattle have access to the stream in this area and the banks are trampled.

Recommendation: Fence to restrict cattle access.

HOLLAND RIVER EAST BRANCH
TRIBUTARY A (WESTERN CREEK)

N3-A5-TA-1-W (rating 5)

This site is located upstream from the point where this tributary enters the main stream. There is a gully at the culvert under the driveway along the west bank of the main stream. The gully is 5m deep and it has cut back 1.2m into the bank. The gully has been caused by road runoff.

Recommendation: Place a gabion basket retaining wall around the culvert.

TOPO-A5-TA-2-W (rating 3)

This site is located directly across from the end of Simcoe Street. The slumping of the 3m high west bank extends for approximately 50m along the shoreline. On the east bank a gabion basket retaining wall has been installed.

Recommendation: Install a gabion basket retaining wall along the west bank.

TOPO-A5-TA-3-EW (rating 2)

Surrounding the two culverts on Queen Street west of Lorne Street is some minor undercutting. The water coming out of the west culvert drops 20cm to the stream below. There is no water coming through the east culvert. The undercutting is due to runoff from the street.

Recommendation: Place riprap along both sides of the culverts.

TOPO-A5-TA-4-EW (rating 2)

At this site in Hasket Park there is slumping of the 1m high banks on both sides of the stream. On the west side, the slumping has been caused by runoff from a large field. On the east side, the slumping has been caused by runoff from a residential yard.

Recommendation: Regrade and revegetate the banks.

TOPO-A5-TA-5-EW (rating 1)

The east bank is undercut at the end of Avenue Road. The stream cuts around an obstruction of metal bars that stand straight up in the stream.

Recommendation: Remove the obstruction.

TOPO-A5-TA-6-EW (rating 1)

Water from a tile drain has eroded a channel 3m long and 1m deep as it flows to the stream. This site is located west of Highway #11 near Eagle Street.

Recommendation: Construct a proper drainage outlet.

HOLLAND RIVER EAST BRANCH
TRIBUTARY B (BOGART CREEK)

N3-U22-TB-1-E (rating 1)

Downstream from the bridge at Prospect Street in Newmarket there is a gully. The 1m wide gully reaches to the top of a 2m high bank that is 90% covered with grasses. The cause of the gully is runoff from the road.

Recommendation: Regrade and vegetate the east bank.

N3-U22-TB-2-W (rating 3)

Thirty meters upstream from the Prospect Street bridge is a site of undercutting that extends 15m along and 1.2m up the 1.5m high west bank. The stream is littered with wooden and metal debris, concrete blocks and garbage.

Recommendation: Regrade and line the west bank, remove the debris.

N3-U22-TB-3-E (rating 2)

A gully entering from the east conveys runoff from adjacent fields. The gully is 10m long, 1.2m wide and 0.8m deep. The sides of the gully are bare except for some grasses and branches.

Recommendation: Regrade and vegetate the east bank.

N6-U22-TB-4-W (rating 3)

Undercutting at this site 20m downstream from the Srigley Street bridge extends for 9m along the 1m high west bank. This bank is 10% covered with grasses. Directly across the stream is erosion around a drainage outlet.

Recommendation: Regrade and revegetate west bank. Construct a proper drainage outlet.

N6-U22-TB-5-E (rating 4)

A large gully 2.2m wide, 1.4m deep and 3.1m long has eroded the east bank from bottom to top. The bank has no vegetative cover. The gully conveys runoff from a commercial storage yard on Charlotte Street in Newmarket to the stream. There is a fence across the top of the bank that is falling into the gully. The mouth of the gully is filled with sediment.

Recommendation: Regrade and vegetate the east bank. Construct a drop structure to accommodate runoff from the yard.

N6-U22-TB-6-W (rating 3)

Sloughing affects a 5m stretch of the 4m high west bank on the bend in the stream. The slope is well vegetated except for a strip down the middle of the area where runoff is starting to create a gully. An old fence has slid down the slope and a new fence has been erected 1m further back from the edge. Several trees threaten to fall into the stream.

Recommendation: Remove the old fence and any trees that may fall and cause an obstruction, regrade and revegetate the slope where required.

N6-U22-TB-7-W (rating 3)

At this former bridge site there is a log jam around the remaining pieces of concrete. Undercutting affects the west bank which rises 2.1m at an angle of 75 degrees. The banks have a 40% coverage of grasses along this 9m stretch. The undercutting is caused by the diversion of the stream due to the logs and concrete on the east side.

Recommendation: Remove the obstruction and regrade and revegetate the west bank.

N6-U22-TB-8-W (rating 3)

For 3m along this bend the 5m high west bank is sloughing into the stream.

Recommendation: Regrade and vegetate the west bank.

N6-U22-TB-9-W (rating 3)

Undercutting of the 1.2m high west bank extends for 14m along the stream. This site is located approximately 100m west of Stewart Street in Newmarket. The bank has a 20% vegetative cover of grasses. There is a fence obstruction upstream.

Recommendation: Regrade and revegetate the west bank. Remove the debris caught in the fence and raise the fence to prevent it from catching additional debris.

N6-U22-TB-10-W (rating 2)

The west bank drops 2m at a 90 degree angle to the stream. The bank is bare for 6m and soil falls from the face of the bank into the stream.

Recommendation: Regrade and vegetate the west bank with stabilizing plants.

N8-U25-TB-11-EW (rating 1)

Undercutting affects 0.6m of the 1m high banks. There are many trees that have fallen into the stream due to the marshy conditions.

Recommendation: Line the banks with sabilizing vegetation and remove any diversion causing obstructions.

N8-U25-TB-12-E (rating 2)

Water flowing from a spring is causing the erosion of a large hill on the east bank of the stream at this site downstream from Bogarttown. The forest changes abruptly from cedars on marshy black soil to spruce and pine trees on sandy soil. The spring runs right along the margin. There is a large amount of sediment in the stream at the junction of the spring and the stream.

Recommendation: Install seepage drains.

N8-U25-TB-13-EW (rating 1)

Cattle trampling is responsible for the large amount of sediment in the stream at this site.

Recommendation: Fence to restrict cattle access.

N8-U25-TB-14-EW (rating 3)

At this site the stream branches to flow around an island. The west branch is not flowing at present, the water within the branch is stagnant. Along the east branch for 15m there is undercutting of the 1m high banks. A major log jam at the point where the stream splits has caused the stream to change its course.

Recommendation: Regrade and revegetate the banks. Clear the log jam.

N9-U25-TB-15-EW (rating 3)

This site of cattle trampling is found north of the bridge at Mulock Sideroad east of Leslie Street. The trampling extends for 10m along both of the 1.2m high banks.

Recommendation: Fence to restrict cattle access and construct a cattle watering station.

N10-U25-TB-16-E (rating 2)

Slumping is occurring along 8m of a large curving bend in the stream and affects 1.5m of the 1.6m high east bank. A few trees have fallen into the stream as a result. There are rocks at the base of the slope.

Recommendation: Regrade and revegetate the east bank.

N10-U25-TB-17-E (rating 1)

At this site the erosion extends for 2.4m along the shoreline and affects 0.6m of the 1m high east bank. The site is found along a straight stretch of the stream.

Recommendation: Install a riprap lining along the bank.

N12-A4-TB-18-E (rating 1)

This site is located east of Woodbine in the area of a Conservation Authority restricted cattle access fencing project. On a hill 100m east of the stream there is a large manure pile. Runoff from the pile may enter the stream.

Recommendation: Implement proper manure handling practices.

N12-A4-TB-19-E (rating 3)

This site is located within the newly fenced area. A gully here is 15m long, 1.2m deep and 2.1m wide. The gully conveys runoff from a nearby cornfield to the stream.

Recommendation: Fill the gully and revegetate the east bank.

N12-A4-TB-20-W (rating 3)

The undercutting at this site extends for 6m along the west bank and affects all of the 1.4m high bank. The site is located on the streambend that has been fenced to restrict cattle access.

Recommendation: Regrade and revegetate the west bank.

K60-A4-TB-21-EW (rating 2)

This site is located west of the 5th Concession south of St. John's Sideroad. The 1.2m high banks have been trampled by cattle.

Recommendation: Fence to restrict cattle access and construct a cattle watering station.

HOLLAND RIVER EAST BRANCH
TRIBUTARY C (TANNERY CREEK)

TOPO-A8-TC-1-W (rating 2)

This site is located 20m downstream from the bridge at St. John's Sideroad near Highway #11 in Aurora. The stream is 3m wide and approximately 0.6m deep. The banks rise to a height of 1.2m at an angle of 90 degrees. The west bank is undercut to the top of the bank.

Recommendation: Regrade the west bank and plant stabilizing vegetation.

TOPO-A8-TC-2-W (rating 4)

A meander brings the stream to the roadside north of St. John's Sideroad. Undercutting and slumping affect 10m of the west bank that rises 5m from the stream at a 90 degree angle. There are also two small gullies in this bank that cut back toward the road. Road crews and farmers use this location to fill water trucks. A fence crosses the meander twice.

Recommendation: Regrade and line the west bank with riprap or gabion baskets.

TOPO-A8-TC-3-W (rating 4)

Undercutting extends for 10m along the west bank to the top of the 2.4m high banks. Further downstream the undercutting continues to the point where a tributary of Tannery Creek enters from the west.

Recommendation: Regrade and revegetate the west bank where necessary.

TOPO-A12-TC-4-E (rating 4)

Approximately 130m further up the tributary referred to in TOPO-A8-TC-3-W is a gully on the east streambank. Undercutting affects the 2m high west side of the gully. The gully mouth is 2m wide and the gully cuts 7m back into a farm field.

Recommendation: Regrade and vegetate the east bank, construct a proper inlet for the runoff from the field.

TOPO-A12-TC-5-E (rating 3)

This area of cattle trampling stretches for approximately 70m along the tributary of Tannery Creek. The 0.7m high banks are broken down and marshy.

Recommendation: Fence the stream to restrict cattle access and construct a cattle watering station.

TOPO-A8-TC-6-E (rating 2)

At this site on Tannery Creek next to a driveway leading to Highway 11 some gabion baskets are falling over into the stream. This is due to erosion beneath and behind the baskets.

Recommendation: Reconstruct the gabion wall.

TOPO-A8-TC-7-EW (rating 5)

At this site east of Highway #11 on the Newmarket-Aurora boundary is a large meander. Around the bend the banks are undercut all the way to the top of the 1.6m banks. Tree roots are exposed and some trees are about to fall into the stream.

Recommendation: Regrade and vegetate the banks or excavate a new 6m long channel that would bypass this meander.

TOPO-A8-TC-8-EW (rating 3)

Upstream of the railway crossing is cattle trampling along a 1km long stretch of the stream as it flows through a large pasture. There is little or no vegetation left along the banks where the cattle water or cross.

Recommendation: Fence to restrict cattle access and construct cattle watering/crossing stations.

Lake Simcoe Environmental Management Strategy Reports

A. Land Sub-Group. 1985. Overview of Phosphorus Sources, Loads and Remedial Measures Studies.

A.1 Frank, D., D. Henry, J. Antoszek and F. Engler. 1985. " Lake Simcoe Tributary Water Quantity and Quality Data Report."

A.2 Frank, D., D. Henry, T. Chang and B. Yip. 1985. "Newmarket Urban Test Catchment Data Report."

A.3 Antoszek, J., T. Stam and D. Pritchard. 1985. "Streambank Erosion Inventory. Volume I."

A.3 Antoszek, J., S. Meek, K. Butler and O. Kashef. 1985. "Streambank Erosion Inventory. Volume II."

A.4 Rupke and Associates. 1985. "Calibration Summary of Holland Marsh Polder Drainage Pumps."

A.5 Limnos Limited. 1985. "Phosphorus Control by Duckweed Harvest - Holland Marsh Polder Drainage System."

A.6 Land Sub-Group. 1985. "Phosphorus and Modelling Control Options."

B. Lake Sub-Group. 1985. "Overview of Lake Simcoe Water Quality and Fisheries Studies."

B.1 Humber, J.E. 1985. "Water Quality Characteristics of Lake Simcoe - 1980-1984."

B.2 Neil, J.H. and G.W. Robinson. 1985. "Dichotomosiphon tuberosus, a benthic algal species widespread in Lake Simcoe."

B.3 Angelow, R. and G. Robinson. 1985. "Summer Nutrient Conditions in the Lower Holland River prior to Diversion of Municipal Inputs."

B.4 Neil, J.H., G.A. Kormaitas and G.W. Robinson. 1985. "Aquatic Plant Assessment in Cook Bay, Lake Simcoe."

Gault, H.D. 1985. "Community Relations Report."

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